COLONIAL REPORTS—ANNUAL.

No. 500.

THE SURVEYS AND EXPLORATIONS

OF

BRITISH AFRICA.

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE

FIRST YEAR.

To August, 1906.

Presented to both Houses of Parliament by Command of His Majesty.
October, 1906.

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WEST OF VICTORIA NYANZA.
PILLAR NO. 8.

25953

No. 500.

COLONIAL SURVEY COMMITTEE REPORT, AUGUST, 1906.

The following Report, which was considered at a meeting of the Colonial Survey Committee held on the 26th of September, 1906, has been submitted to and approved by the Secretary of State for the Colonies.

R. C. HELLARD, *Colonel.*
H. J. READ.
C. F. CLOSE, *Major, R.E.*
W. C. BOTTOMLEY.
C. H. LEY, *Captain, R.E.* } *Secretaries.*

I.

INTRODUCTION.

(i.) Necessity for Explorations and Surveys.
(ii.) The Colonial Survey Committee.
(iii.) System and Method.
(iv.) Uniformity.
(v.) Topographical Maps and Cadastral Plans.
(vi.) Map of Africa. Topographical Section General Staff.
(vii.) Employment of Natives.
(viii.) Geographical Attachment of Africa to Europe.
(ix.) The 30° Meridian Arc.
(x.) Boundary Commissions.

(i.) NECESSITY FOR EXPLORATIONS AND SURVEYS.

The purposes for which maps are required in the administration of a country (especially an undeveloped country such as a protectorate in Tropical Africa) are many and varied.

Maps are necessary to define the exact limits of national territory, to show the areas and villages under the rule of native chiefs, they are essential for land registration and settlement, for the allotment of mining and forest concessions, and for the organization of internal communications.

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Of their necessity in war the experiences of the army in South Africa afford an eloquent testimony, and even the conduct of a "small war" or a police expedition is much simplified by the existence of reliable maps of the scene of operations.

(ii.) The Colonial Survey Committee.

The Colonial Survey Committee is an Advisory Committee formed at the instance of the Secretary of State for the Colonies to advise him in matters affecting the survey and exploration of British Colonies and Protectorates, more especially those in Tropical Africa.

The Committee was constituted in August, 1905, and consists of:—

A representative of the Colonial Office.
The Director General of the Ordnance Survey.
The officer in charge of the Topographical Section of the General Staff.

It is the duty of the Colonial Survey Committee to make such recommendations as will ensure the rapid and economical prosecution of accurate surveys where these are required, and the rendering the results available, as speedily as possible, for use by the Home Government, the Colonial Governments, and the public.

(iii.) Necessity for System and Method.

The enquiries of the Colonial Survey Committee have disclosed a want of system and method in certain of the survey departments of the Tropical African Colonies and Protectorates. The absence of a methodical scheme of work has too often resulted in partial and incomplete surveys and in some instances impossibilities have been attempted. The attention of Governors and Commissioners is now drawn "to the importance of enforcing the rule that work should be taken up systematically by blocks according to a definite programme." This a principle which cannot be too strongly insisted upon, but which has been largely neglected in the past; the observance of this principle is a fundamental condition of efficient and economical work.

(iv.) Uniformity.

The great variety of the natural conditions of the surface features of the Tropical Protectorates renders it impossible to lay down any uniform system of work in the field. Each case must be dealt with on its merits. The technical methods suitable for different types of country (such, for instance, as undulating grass regions, forest clad mountainous tracts, deserts or mangrove swamps) are well known.

Uniformity is, however, required in the following particulars :—

(*a.*) The figure of the earth adopted is that of Clarke.

(*b.*) The Topographical Maps are to be bounded by meridians and parallels, and the border lines are to fit in with the intervals adopted by the Topographical Section of the General Staff for the map of Africa on the scale of $\frac{1}{1000000}$.

(*c.*) The scales to be used are the following :

Topographical Maps.	Cadastral Plans.
$\frac{1}{63360}$	$\frac{1}{2500}$
$\frac{1}{125000}$	$\frac{1}{5000}$
$\frac{1}{250000}$	$\frac{1}{10000}$
$\frac{1}{500000}$	
$\frac{1}{1000000}$	

In exceptional cases where large scale town plans are required the following scales may be adopted $\frac{1}{500}$, $\frac{1}{1000}$.

(v.) Topographical Maps and Cadastral Plans.

A Topographical Map is an accurate graphic representation of a portion of the earth's surface showing all the accidents of the surface, both natural and artificial, which can be depicted on the scale selected. Such maps are usually on small scales, but any complete representation of a portion of the earth's surface which shows natural features (including the "relief"), and such artificial features as the scale will permit, is a Topographical Map.

Examples of Topographical Maps are :—

The $\frac{1}{63360}$ (1 inch to a mile) Ordnance Map of England.
The $\frac{1}{80000}$ Map of France.
The $\frac{1}{100000}$ Map of Germany.

A Cadastral Plan, on the other hand, is essentially concerned with the artificial features of the surface, although natural features which affect the object of the plan are also included. Such plans are most frequently required to show property boundaries, and are usually constructed on scales varying from $\frac{1}{10000}$ to $\frac{1}{500}$.

As examples of Cadastral Plans may be quoted, the $\frac{1}{2500}$ plans of the United Kingdom, or the farm plans of the South African Colonies.

(vi.) Maps issued by the Topographical Section of the General Staff.

The Topographical Section of the General Staff is issuing maps of Africa on scales of $\frac{1}{1000000}$ and $\frac{1}{250000}$.

The $\frac{1}{1000000}$ series will be completed in 132 sheets, of which 43 have been published.

Of the $\frac{1}{250000}$ series 185 sheets have been published.

The $\frac{1}{1000000}$ series is printed in colours, in which form it is also hoped to eventually publish the $\frac{1}{250000}$. At present, however, the $\frac{1}{250000}$ is published in a provisional form in black only.

The published sheets cover generally the Anglo-Egyptian Sudan, British East Africa, Nigeria, and the Gold Coast.

The material from which the map of Africa has had to be constructed is not of a character from which it is possible to make a generally accurate map. The mass of the available material consists of sketches made by travellers and explorers and by civilians and military officials when touring on duty or accompanying military expeditions.

The survey work of the various Boundary Commissions which have delimited the British possessions forms the framework into which the sketches above-mentioned have been fitted. In addition accurate traverses have been made on the Gold Coast; some theodolite and plane-table work has been done in Lagos, Somaliland, British Central Africa, and Uganda, and the longitude of a few places in the Sudan and Nigeria have been determined by the telegraph.

The above paragraph will serve to show the data from which the official maps of Africa have been compiled, and gives some idea of the degree of accuracy they may be expected to attain.

The provisional sheets now published will be withdrawn and will be superseded eventually by sheets based on the accurate surveys of the various British Colonies and Protectorates now being carried out.

(vii.) Employment of Natives.

On general grounds it is desirable to employ natives in the Government service of tropical dependencies to as great an extent as their education and abilities fit them for such service. In the case of the survey departments of the African Protectorates there is the special reason that the exclusive employment of white surveyors is extremely expensive. No satisfactory progress is to be expected in certain protectorates until a class of native surveyor has been developed. This class of surveyor should be capable of carrying out all those survey operations which are customarily performed in India by natives of India.

For this purpose it is desirable to establish a training school in which carefully selected native candidates should be trained on a uniform system. Successful students would be available for employment anywhere in British Tropical Africa. The question of the formation of this school is now under consideration.

There should be no difficulty in finding natives intelligent enough to carry out the duties above indicated, if we may judge by the case of the late Mr. G. E. Ferguson, a native of the Gold Coast, who possessed high qualifications as a surveyor and carried out, single-handed and under very adverse conditions, extensive surveys and explorations of a high order of excellence in the country at the back of the Gold Coast. The chief difficulty at first will be found in developing that habit of scrupulous honesty which is the chief essential of a surveyor's character. This habit of mind can be formed by a system of checks and punishments until the native surveyor's conscience becomes as tender as the conditions of the case require.

A commencement in this matter has been made in Lagos, where native surveyors have been trained with considerable success.

(viii.) The Geographical Attachment of Africa to Europe.

The continent of Africa is attached geographically to Europe in the following way. The geodetic triangulation of Algeria is connected with that of Spain by rays which cross the Mediterranean. The same triangulations are also connected astronomically by exchange of telegraphic signals for longitude. The difference of longitude between Suez and Greenwich has been determined telegraphically, and the difference of longitude between Cape Town and Greenwich has been determined in the same way. Based on the value for Suez are all the surveys of Egypt and the Anglo-Egyptian Sudan. Based on the value for Cape Town is the whole of the geodetic triangulation of South Africa. Based also on Cape Town by exchange of telegraphic signals are the positions of Accra, Bonny, and Lagos on the West Coast, and on the positions of these towns depend the surveys of the Gold Coast and of Southern and Northern Nigeria, in which a large number of telegraphic longitudes have recently been determined. British Central Africa and the Lake Nyasa region depend on the longitude of Nkata, near the western shore of that lake, which was fixed by telegraph from Cape Town. From Cape Town also has been determined the position of Zanzibar, and on the latter depends the longitude of Mombasa. From Mombasa a good (but not geodetic) chain of triangles extends to Kilimanjaro and Victoria Nyanza and on to Albert Edward Nyanza and Ruwenzori. The longitude of Port Florence on Victoria Nyanza has also been fixed telegraphically from Mombasa.

(ix.) The 30° Meridian Arc.

It is here necessary to mention a scheme of great practical and scientific importance which is in a fair way towards fulfilment.

Sir David Gill has suggested the measurement of a chain of triangles along the meridian 30° east of Greenwich, from the south of Natal to Cairo. At intervals astronomical determinations are made, and the process is what is known as "the measurement of an arc of meridian"—of a length hitherto unattempted. Such an arc serves to determine the shape of the meridian curve, and hence the figure of the earth; and in this case its scientific value consists not only in its great length—65 degrees, or 4,500 miles—but also in the fact that it crosses the Equator.

The practical aspect of the undertaking is also important. This chain of rigorous triangles will serve to tie together the surveys of all the countries through which it passes, and in every case it will afford a series of exactly measured lines on which all the geographical work of those countries will be based.

At present (including a small portion between the Limpopo and Gwelo, now being executed) the chain has been completed from the south northwards for over a thousand miles. The money for this undertaking has so far been found almost entirely by the South African Colonies and the British South Africa Company. The delimitation of the Uganda-Congolese boundary will afford the means of measuring 2½ degrees of the equatorial portion of the arc.

(x.) Boundary Commissions.

The delimitation of international frontiers has been an indirect means of surveying some of the outlying portions of the tropical protectorates. In fact, in most of our tropical African possession the perimeter is more accurately mapped than the interior. There are now no "hinterlands" in British Africa, the partition of the continent is complete, and the boundaries are, with few exceptions, well defined.

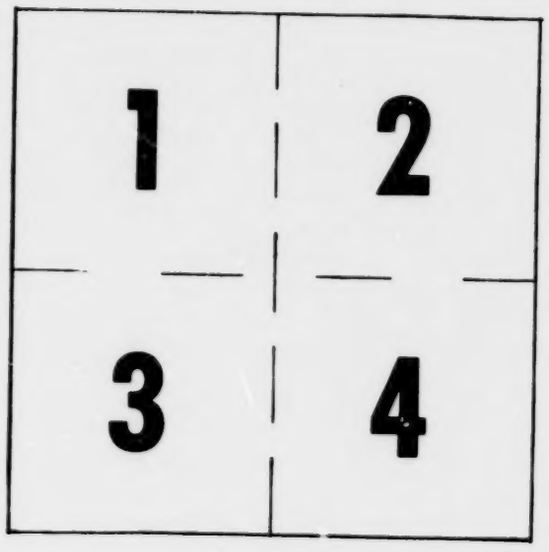
The labours of the boundary commissions and of individual explorers have in some instances disclosed errors in the maps upon which the international agreements were based.

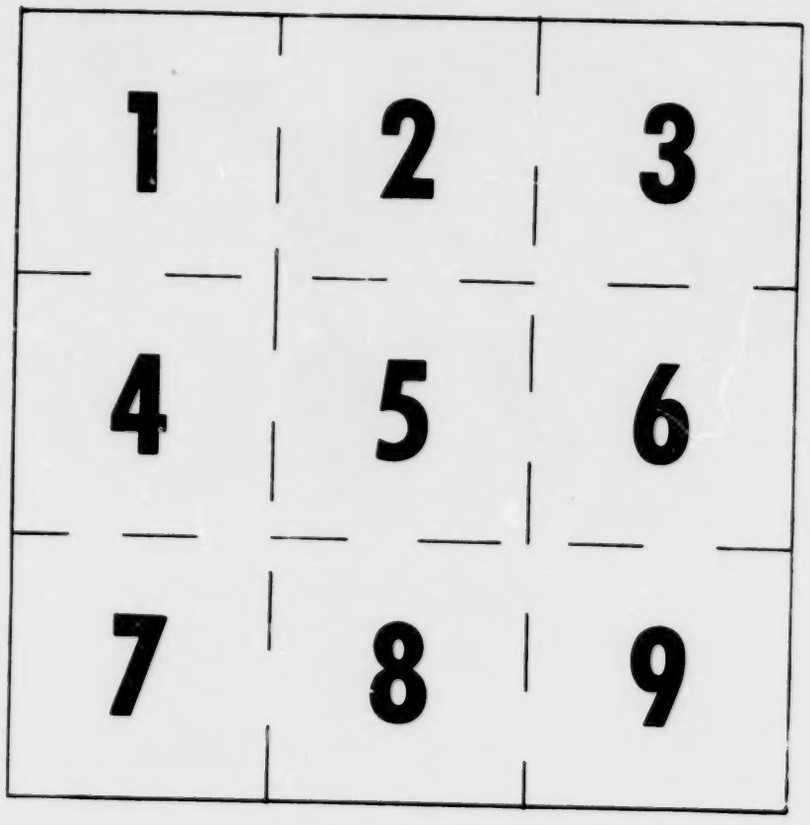
The following are some of the more striking of these errors:—

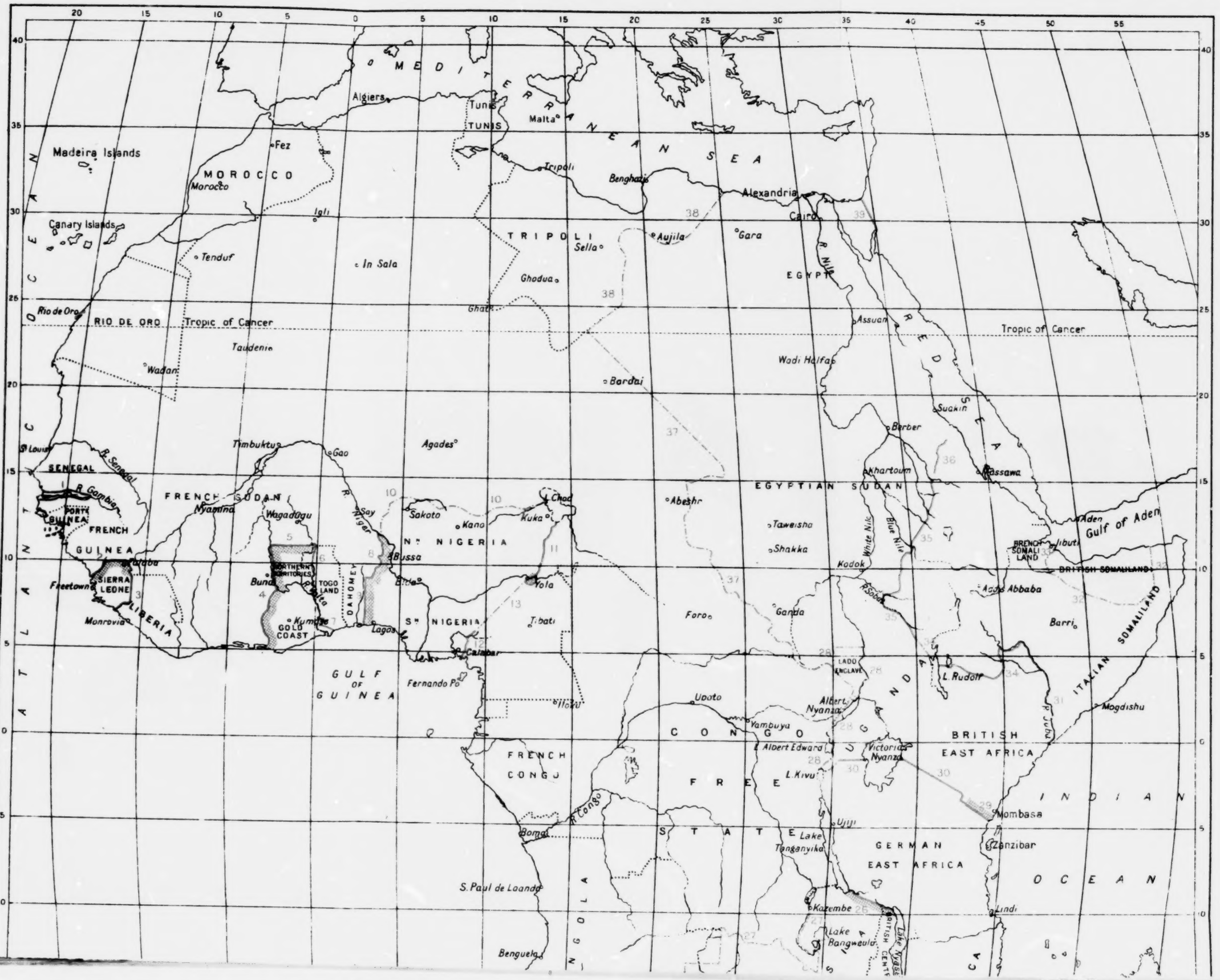
Lake Chad is found to be, not a great navigable inland sea, but two large shallow pools never more than five feet deep, surrounded by swamps.

The meridian 30° east of Greenwich does not pass through Lake Albert Edward; the British agreement with the Congo Free State was, therefore, based upon a misconception.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.



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Fez
MOROCCO
Morocco
Tripoli
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TRIPOLI
Sella
Aujila
Gara
Tenduf
In Sala
Ghodua
Ghat
EGYPT
R. Nile
Rio de Oro
RIO DE ORO
Tropic of Cancer
Taudenia
Assuan
Wadan
Wadi Halfa
Bardai
RED SEA
Suakin
Berber
Timbuktu
Gao
Agades
St Louis
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BRITISH SOMALILAND
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Addis Abbaba
Ganda
Foro
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SOMALILAND
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Mombasa
INDIAN OCEAN
Lake Tanganyika
GERMAN EAST AFRICA
Zanzibar
S. Paul de Loanda
Kazembe
Lindi
Lake Bangweulo
Benguela
ANGOLA
ATLANTIC OCEAN

DIAGRAM
TO ILLUSTRATE
THE
PROGRESS OF THE DELIMITATION
OF
BRITISH FRONTIERS IN AFRICA

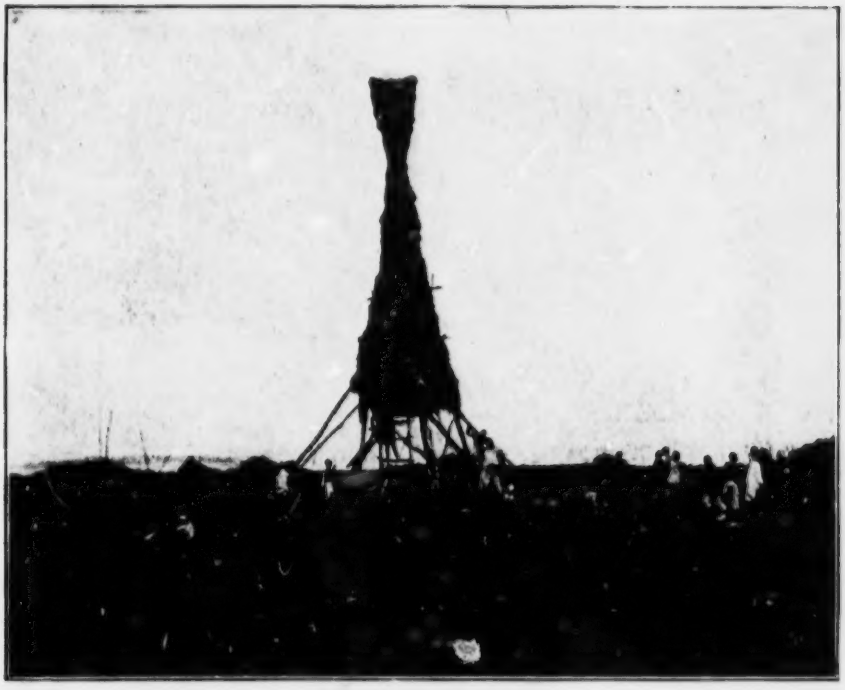
Scale of the Diagram

Miles 100 0 100 300 500 700 900 Miles

British Boundaries marked & ratified
Do Do surveyed
Do Do not yet surveyed

T.S.G.S. Nº 2226 (a)

War Office August 1906.



ANGLO-GERMAN BOUNDARY.
WEST OF VICTORIA NYANZA, 1904.
TRIGONOMETRICAL SIGNAL.

The outflow from Lake Bangweulu runs in a different direction to that which suggested the Rhodesia-Congo agreement.

In 1891, Stuhlmann found that the Mfumbiro peaks were to the west of the meridian 30° east of Greenwich.

There were also, as was inevitable, many minor misconceptions. Thus the Cross River "rapids" were found to be much over-described and were misplaced twenty miles in longitude.

The technical work of boundary commissions has shown a steady improvement, and these commissions have had a considerable share in stimulating interest in geographical surveying. Excellent technical work has been carried out by the most recent commissions—the Yola-Chad, the Anglo-German (Uganda), the Victoria-Kilimanjaro, and the Anglo-Portuguese (Zambesi). To these and other commissions we owe much exact geographical knowledge—a most useful asset to the protectorates concerned.

The total length of international frontiers traversed by British Boundary Commissions in Africa up to August, 1906, is 9,081 miles.

The following are the stages in the business of delimiting an international frontier. First there is an international agreement drawn up on broad lines; each Government then appoints Commissioners, who meet at one end of the boundary and march along it, exploring and mapping the boundary zone. The Commissioners, having arrived at the other end, agree upon the geographical position of the principal features and decide upon the details of the frontier, paying special attention to the incidence of tribal boundaries and to the future nationality of the villages. They then march back along the line, erect pillars and inform the chiefs. A protocol in duplicate is drawn up and signed, and each Chief Commissioner forwards the protocol and maps with a report to his Government. The protocol is then approved by the two Governments, and in some instances a fresh agreement on the terms of the protocol (with perhaps minor modifications) is drawn up and signed by representatives of the Governments.

Not every commission has followed this course exactly, but the above sketch of procedure will serve to indicate the various stages through which frontier negotiations usually pass.

Section II. of this Report consists of a list of Boundary Commissions, showing the frontiers which have been delimited and the progress made in each case.

II.

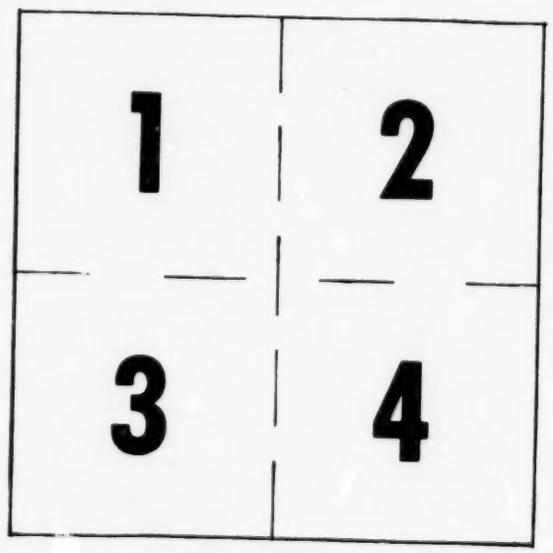
TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

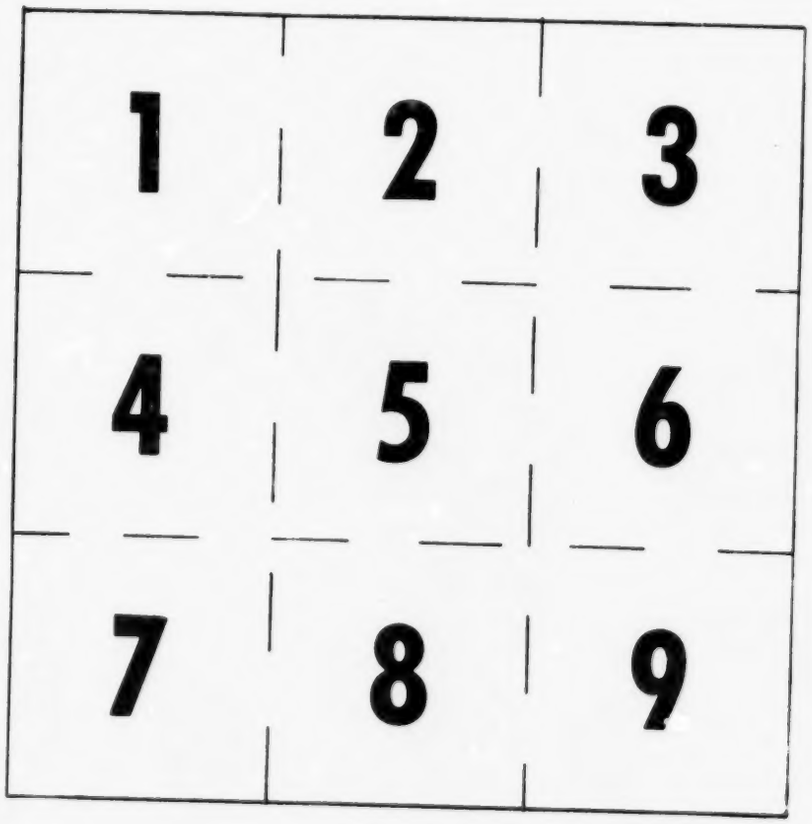
Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
1	Gambia (Anglo-French)	425	Aug. 10th, 1889	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Leconte, Civil Administrator.	Nov., 1890, to May, 1891.	May, 1891	May, 1891.	—	—
1	" "	—	" "	British :— Mr. Reeve. Mr. Ozanne. French :— M. Fargue. Lieut. de Jussien. M. Robert (Interpreter).	1895-6.	—	—	—	—
1	" "	—	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898-9.	—	—	—	—
1	" "	—	April 4th, 1904	British :— Major Cowie, W.I.R	1905-6	—	—	—	—
2	Sierra Leone—French Guinea.	260	Convention, Jan. 21st, 1895.	British :— Capt. A. H. Kenney, R.E. French :— M. Lamadon, Governor of the French Colony of Les Rivières-du-Sud	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembi-Kunda.
2	" "	—	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Millot.	Dec., 1895, to May, 1896.	1895, 1896	April 30th, 1896	—	From the Coast to Tembi-Kunda.

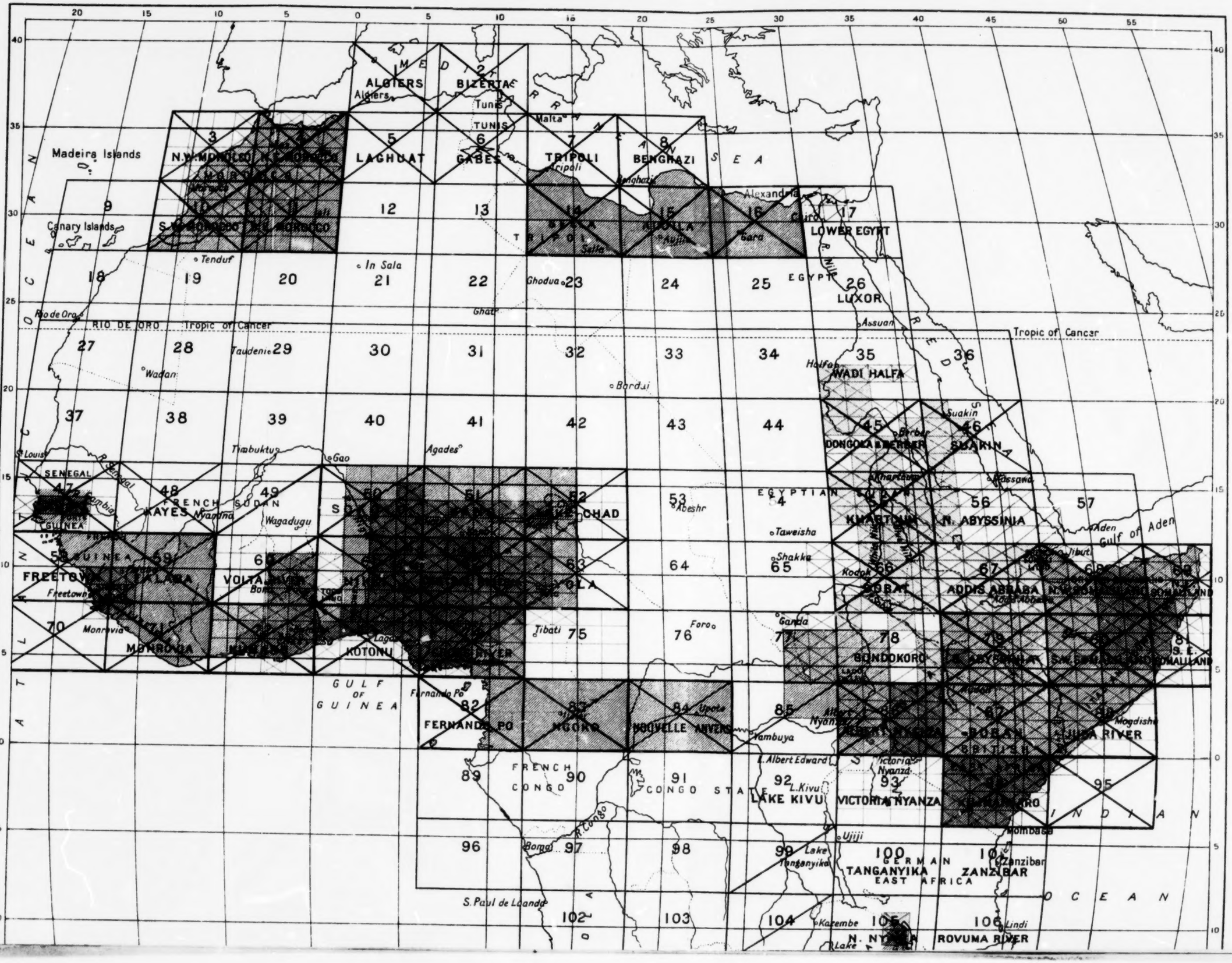
2	" "	—	Jan. 15th, 1903	British :— Mr. Birch. French :— M. Lescure.	1900 and Jan. 15th, 1902.	1903.	Mar. 3rd, 1903.	March and April, 1904.	Tembi - Kunda, Eastwards.
3	Sierra Leone—Liberia ..	195	" "	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E.	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	—	—
4	Gold Coast—Ivory Coast Anglo-French).	450	July 12th. 1893	British :— Major A. E. G. Watherston, R.E. Capt. Soden. R. Fus. Capt. H. B. Des Voeux, R.E. French :— M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903.	Feb. 1st, 1903.	May, 1905	—
5	Gold Coast, Northern Territories — French Sudan.	195	Convention, June 14th, 1898.	British :— Major A. E. G. Watherston, R.E. Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	1904.	Aug. 16th, 1901.	May, 1906.	—
6	Gold Coast, Northern Territories — Togo (Anglo-German).	165	Convention, July 1st, 1890, and Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried.	Dec., 1901, to Sept., 1902.	—	June 9th, 1903.	—	—
6	" "	"	" "	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.	—	Sept., 1904, to Dec. 15th, 1905.	—	—	—
7	Gold Coast — Togoland (Anglo-German).	125	" "	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	—	—	—	—

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	REMARKS.
8	Lagos—Dahomey (Anglo-French).	235		British :— Major J. I. Lang, R.E., C.M.G. French :— Commdt. Toutée.	1900.	—	Dec. 22nd. 1900, and Jan., 1905.	—	From 9° N. Lat. to Niger.
8	" " ..	200		——	1895-6.	—	Oct 12th, 1898. Art. II. June 14th, 1898.	—	From the Coast to 9° N. Lat.
8	" " ..			British :— Capt. Anderson. French :— M. Perreur.	1900.	—	—	—	—
10	Niger—Chad (Anglo-French).	860		British :— Lieut.-Col. G. S. McD. Elliott, R E. Capt. C. H. Foulkes, R.E. Capt. G. R. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906. May 29th, 1906.	—	—
10	" "	"	May 29th, 1906	British :— Major R. P. O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Andoin. Lieut. Vignon.	1906.	—	—	-	Expedition leaves England this Autumn.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.






ALGIERS
BIZERTA
LAGHUAT
GABES
TRIPOLI
BENGHAZI
N.W. MOROCCO
S.W. MOROCCO
N.E. MOROCCO
S.E. MOROCCO
LOWER EGYPT
LUXOR
RIO DE ORO
WADI HALFA
DONGOLA & BERBER
SUAKIN
KHARTOUM
N. ABYSSINIA
KAYES
SENEGAL
FRENCH SUDAN
CHAD
FREETOWN
FREETOWN
VOLTA RIVER
KOTONU
MONROVIA
GUINEA
FERNANDO PO
NGOKO
NOUVELLE ANVERS
LAKE KIVU
VICTORIA NYANZA
ADDIS ABABA
GONDOKORO
S.E. SOMALILAND
JUBA RIVER
TANGANYIKA
ZANZIBAR
EAST AFRICA
ROVUMA RIVER
Madeira Islands
Canary Islands
Tropic of Cancer
Tropic of Cancer
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Ghadua
Ghat
Rio de Oro
Assuan
Taudenie
Wadan
Bordj
Halfa
Suakin
Berber
Khartoum
Kassawa
Abeshr
Taweisha
Shakka
Aden
Gulf of Aden
Timbuktu
Gao
Agades
St Louis
Senegal
Gambia
Bathurst
Myauna
Wagadugu
Freetown
Monrovia
Lagos
Tibati
Foro
Ganda
Fernando Po
Uporte
Yambuya
L. Albert Edward
Victoria Nyanza
Mombasa
Ujiji
Lake Tanganyika
Borno
S. Paul de Loanda
Kazembe
Lindi
Mogdisho
Zanzibar
Gulf of Guinea
French Congo
Congo State
Egypt
Egyptian Sudan
Nile
Niger
Benue
Congo
Zambesi
Atlantic Ocean
Indian Ocean
Red Sea
Mediterranean Sea
Libya
Desert

AFRICA

INDEX TO SHEETS ON SCALE OF 1/1,000,000 & 1/250,000

Scale of the Index

Miles 100 0 100 300 500 700 900 Miles

REFERENCE

Scale 1/1,000,000 shewn in Blue

Scale 1/250,000 shewn in Red

Work in Hand

Manuscript compiled Sept 1906

Sheets published

I.D.W.O. N° 1544 1725

Tropic of Capricorn

Gulf of Aden

Gulf of Guinea

Lake Kivu

Lake Tanganyika

Lake Bangweolo

R. Congo

R. Zambezi

Victoria Falls

Kilimane

Mozambique

Lindi

Zanzibar

Mombasa

Lorenzo Marques

Cape Town

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Durban

Pretoria

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Freetown

Monrovia

Accra

Lagos

Kotonu

Fernando Po

Foroo

Gondokoro

Victoria Nyanza

Albert Edward

Kivu

Ujiji

Bomba

Benguela

S. Paul de Loanda

Kazembe

Sitanda

Tete

Beira

Inhambane

Delagoa Bay

Port Nolloth

Prieska

Bloemfontein

Orange River Colony

Natal

Cape Colony

Transvaal

Angra Pequena

Walfisch Bay

Omaruru

Windhoek

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Molopo River

Kunene River

Andara

Okavango

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Kalahari

Mossamedes

Liaoui

Nyassa

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Somaliland

Abyssinia

Addis Ababa

Aden

Taweisha

Shakka

Kodok

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Tibati

Yambuya

Nyam Nyam

Uganda

Somali Desert

Ogaden

Mogdishu

Juba River

Tana River

Indian Ocean

Atlantic Ocean

French Congo

Congo State

German East Africa

German South West Africa

Portuguese East Africa

Portuguese West Africa

Gold Coast

Ashanti

Dahomey

Togoland

Sierra Leone

Liberia

Guinea

Fernando Po

Nouvelle Anvers

Upoto

Bonga

Lado

Wadelai

Mahagi

Kavalli

Kilimane

Sofala

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Crocodile River

Transvaal

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11	Yola—Chad (Anglo-German).	350	Convention, Nov. 15th, 1893. Preliminary Agreement, Dec. 14th, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E. Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Feb., 1903, to Feb., 1904 and 1905.	—	Feb. 24th, 1904, and Mar. 19th, 1906.	Aug. 24th, 1906.	—
12	Cross River (Southern Nigeria—Kameruns).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug., 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th, 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1895.	—	—	—	—
12	" "	"	" "	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	—
13	Cross River Rapids—Yola Arc.	285	—	—	—	—	—	—	Not yet delimited.
14	Barotseland—Angola ..	710	Convention, July 29th, 1901, and Arbitration award, May 30th, 1905.	—	—	—	—	—	Not yet delimited.
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	—	—	—	—	—	Not yet delimited.
16	Bechuanaland—German South-West Africa.	1113	July 1st, 1890, Art. III. (A.G.); Dec. 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British — Major H D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1898 to 1903.	—	—	Part only of boundary delimited.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
17	Amatongaland — Portuguese East Africa.	30	June 11th, 1891, Art. III.	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes de Selva.	Aug., 1896, to Dec., 1896.	—	—	—	—
17	" "	"	" " "	British :— Mr. W. Bosman. Portuguese :— Lieut. M. Newparth.	—	Oct., 1897.	—	—	—
18	Swaziland — Portuguese East Africa.	65		—	1888, 1894, and 1897.	—	—	—	Portuguese and Boer Commission.
19	Transvaal — Portuguese East Africa.	255	July 29th, 1869. Convention of London, Feb. 27th, 1884.	—	1887, 1890, and 1894.	1887, 1890, 1894.	—	—	Portugese and Boer Commission.
20	Limpopo River to Sabi River (Anglo - Portuguese).	115		—	Dec. 1902, to 1905.	—	—	1905.	—
21	Mazoe or Manica Boundary (Anglo - Portuguese).	235	June 11th, 1891	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	—	Arbitral award, 1897.
21	" "	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade.	—	1898 1899.	June 5th and 28th, 1898 and Dec 14th and 15th, 1898.	—	—

22	Barue Boundary (Anglo-Portuguese).	145	June 11, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E.	1898.	1905 to	Dec. 28th, 1906.	—	—
23	Anglo-Portuguese Boundary South of River Zambesi.	215	„	British :— Mr. Sawerthal. Portuguese :— Lieut. Durao.	1903-4.	—	—	—	Provisional survey.
23	„ „	215	„ „	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. S. Gugo Coutinho.	April, 1905, to Oct., 1905.	1905.	Oct. 20th, 1905.	—	—
24	Anglo-Portuguese Boundary North of Zambesi	260	„ „	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. S. Gugo Coutinho.	June, 1904, to Nov., 1904.	1904.	Nov. 22nd, 1904.	—	—
25	British Central Africa—Portuguese East Africa (Anglo-Portuguese).	660	„ „	British :— Mr. A. James Swann. Mr. Thomas J. Binnie, Surveyor.	1899-1901.	1899-1901.	—	—	Provisional Boundary Commission.
26	Nyasa-Tanganyika (Anglo-German).	225	July 1, 1890	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Boileau, R.E. Capt. Chichester. Lieut. Scratchley. German :— Hptmann Herrmann. Leut. Glauning. Dr. Kohlschütter.	1898.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—
27	Congo Free State—North-West Rhodesia.	1200	May 12th, 1894	——	—	—	—	—	Not yet delimited.

Red Nos. on Maps.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS
28	Congo Free State—Uganda and Sudan.	800	May 12th, 1894, and May 9th, 1906.	—	—	—	—	—	—
29	British — German East Africa (Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith. R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 25th, 1893.	—	—
29	„ „ „	„	July 25th, 1893	British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897	1900.	Jan. 28th, 1900.	—	Not beaconed throughout its entire length.
30	British — German East Africa (South end of Jipe to Lake Victoria).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright. Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	—
30	German East Africa—Uganda.	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W Schwartz. Oblt. M. Weiss.	July, 1902, to Apr. 1904.	1904	July 18th, 1906.	—	—
31	Italian Somaliland — British East Africa.	375	Italian agreement of May 5th, 1894.	—	—	—	—	—	Not yet delimited.

32	British Somaliland — Italian Somaliland.	710	Italian agreement, May 5th, 1894.	—	—	—	—	—	Not yet delimited.
33	British Somaliland — French Somali Coast.	50	February 2nd, 1888 ..	—	—	—	—	—	Not yet delimited.
34	Uganda — Abyssinia Boundary.	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900-01.	—	—	—	—
34	" " "	"	—	Capt. P. Maud, R.E. Mr. J. Baird.	Oct., 1902, to July, 1903.	—	—	—	—
35	Sudan—Abyssinia ..	760	Treaty, May 15th, 1902	Major H. H. Austin, R.E. Lieut. C. W. Gwynn, R.E.					
35	" " ..	"	" " "	Brev.-Major C. W. Gwynn, R.E.	1903.	1903.	—	—	—
36	Sudan—Eritrea	330	Treaty, July 10th, 1900, November 22nd, 1901, May 15th, 1902.	British :— Col. the Hon. M. G. Talbot, R.E. Italian :— Major Martinelli. Tenente. A. Pollera. Capt Tornare.	1903.	—	—	—	R. Stetit to Abu Gamal.
36	" " ..	"	" " "	Brev.-Major W. J. Walter, Lancs. Fus.	1899, 1901.	—	—	—	From Sabderat North - Eastwards.
37	Anglo - French — From Congo-Nile Watershed to Tripoli.	1,950	March 21st, 1899 .. Treaty, Series 15, 1899.	—	—	—	—	—	Not yet delimited.
38	Egypt—Tripoli	1,000	—	—	—	—	—	—	Not yet delimited.
39	Egypt—Turkish, Sinai Peninsula.	140	Firman, 1841	British :— Capt. R. C. Owen. Mr. Wade. Mr. Keeling. Turkish :— Mazzaffer Bey. Fehim Bey.	1906.	—	—	—	—

III.

REPORTS ON THE SURVEYS

OF

ANGLO-EGYPTIAN SUDAN.
BRITISH CENTRAL AFRICA.
EAST AFRICA PROTECTORATE.
GAMBIA.
GOLD COAST.
NORTHERN NIGERIA.
SIERRA LEONE.
SOUTH AFRICA.
SOUTHERN NIGERIA (AND LAGOS).
UGANDA.

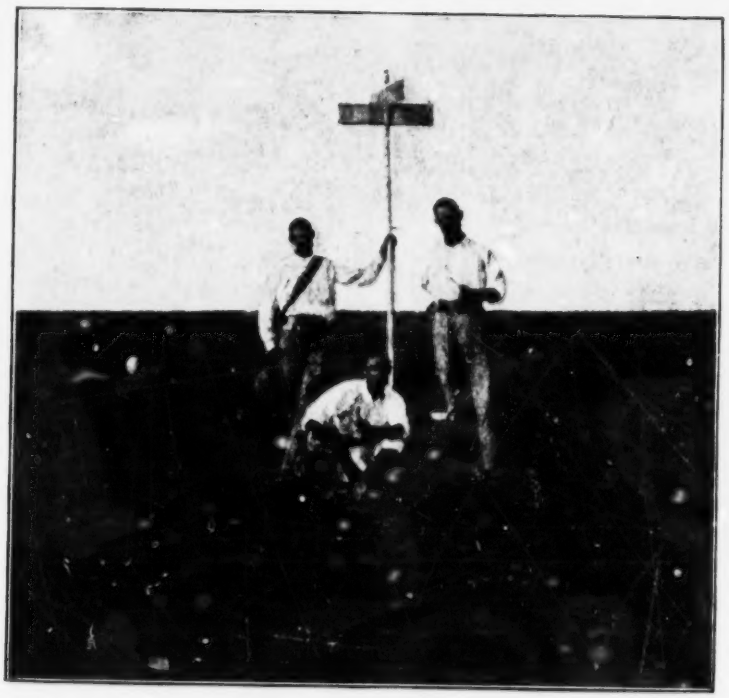
THE ANGLO-EGYPTIAN SUDAN.

Sirdar	... ...	Major-General Sir F. R. WINGATE, K.C.B., K.C.M.G., D.S.O.
Director of Surveys...		Captain H. D. PEARSON, R.E.
Assistant-Director of Surveys	... ...	Lieutenant A. E. CONINGHAM, R.E.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but it has been thought desirable to include an account of these surveys in order to make the review of the mapping of British Africa more complete.

The greater part of the following report has been kindly furnished by the Assistant-Director of Surveys.

(i.) Cadastral Surveys.
(ii.) Natives as Surveyors.
(iii.) Gezireh Survey.
(iv.) Topographical Survey.
(v.) Maps available.



THE GEZIREH SURVEY.

CADASTRAL SIGNAL.

REPORT ON THE SUDAN SURVEYS.

(i.) Cadastral Surveys.

Owing to the fact that the question of ownership of land, necessitated for purposes of taxation, &c., has come largely to the fore during the last two or three years in various provinces in the Sudan, the work required of the Survey Department has been largely increased. To meet this demand Cadastral Surveys have been started: first of all in Dongola Province—where the survey is now nearly finished—and subsequently in Khartoum and Berber Provinces, where the bulk of the work is at present going on. Next season, probably, similar work will be commenced in Halfa Province; but whether in Dongola Province or any other the system of survey is the same.

The work is carried out under the supervision of a survey inspector and one of the inspectors of the province. The former is responsible for everything dealing with the survey, the latter for the correct demarcation of plots and the settlement of disputes as to ownership. The boundaries of the plots are marked by a mud pillar at every change of direction, the sheik of the village being held responsible that these pillars are kept in repair.

(ii.) Natives as Surveyors.

The actual work is done by Egyptian or Sudanese boys—for the greater part trained at the Gordon College—working with a plane-table and chain. Four of these boys are supervised by a survey sub-inspector (Egyptian or Sudanese by nationality), two or more of whom combined form a party under a European survey inspector, who is responsible for the accuracy of the plans made, and connects the several sheets by traverse or tertiary triangulation. Copies of the maps are kept in the Mudiria and the sheik's house.

By this means the river front along the Nile and the adjoining land on both banks is being accurately surveyed in the aforementioned provinces.

(iii.) Gezireh Survey.

In addition to the above work the survey of the Gezireh was commenced in 1905. The Gezireh is a flat tract of land extending southwards from Khartoum for approximately 80 miles between the Blue and White Niles.

The system adopted is as follows:—The land is being divided up into minutes of latitude and longitude, a survey signal of the type shown in the photograph is placed at each corner. This

work is being done by one or more of the survey inspectors. The interior detail is then surveyed by a plane-tabler. The organisation of the parties is the same as for the Cadastral Surveys. It is anticipated that this work will take about four years to complete.

(iv.) Topographical Surveys.

As regards topographical Survey, owing to the necessity of getting the Cadastral Surveys in working order, during the last two seasons comparatively little has been done. Last season the Red Sea Province was surveyed between Suakim and Mahomed Gul by triangulation and plane-tabling, and it is hoped that the extension of this work to the north and west will be possible next season; also that similar work will be carried out in Kordofan, working from El Obeid southwards.

However, much useful work has been done by various inspectors in the Bahr el Gazal and Kordofan Provinces, and the present maps of these provinces are chiefly due to their efforts.

(v.) Maps Available.

The maps available are those on the scales of $\frac{1}{1000000}$ and $\frac{1}{2500000}$, published by the Topographical Section of the General Staff, and the state of publication of these is shown on the attached index. The advanced condition of the geographical exploration of the Egyptian Sudan is principally due to Colonel The Hon. M. G. Talbot, late Director of Surveys, and to Major C. W. Gwynn, C.M.G., D.S.O., formerly Assistant-Director.

BRITISH CENTRAL AFRICA PROTECTORATE.

Commissioner ... ... Sir Alfred Sharpe, K.C.M.G., C.B.

Director of Public Works ... Mr. T. I. Binnie.

(The Public Works Department undertakes the surveys.)

(i.) History of the surveys.
(ii.) Existing state of the maps.
(iii.) Natives as surveyors.

(i.) History of the Surveys.

Mr. H. R. Wallis, Acting Commissioner, gives the following account of steps which have been taken to map the Protectorate :—

"(1) The Survey Department of the British Central Africa Administration was created in May, 1895, on the arrival of Mr. Stotesbury from India with three Indian Surveyors and five linesmen. Another European Surveyor had previously been engaged, but after a brief term of office his services were dispensed with.

"(2) On Mr. Stotesbury's arrival a base was measured near Chiradzulu, 12 miles north of Blantyre, from which were triangulated the hill peaks round Blantyre.

"(3) Surveys and plans of the privately-owned lands in the Shire Highlands were urgently wanted at this time, and the Indian Surveyors and Linesmen at once commenced the work of estate surveying, which occupied the whole Survey Staff until the departure of Mr. Stotesbury from the Protectorate in August, 1896.

"(4) In 1897 a skeleton triangulation was pushed on through Cholo to within 12 miles of Chiromo (on the south), and to 15 miles north of Zomba (on the north), and the work of surveying privately-owned lands continued. This is practically all the triangulation work which has been done in the Shire Highlands, and was carried out in order to survey private estates, and not as part of a comprehensive scheme for mapping the Protectorate generally.

"(5) After most of the privately-owned lands in the Shire Highlands had been surveyed, demands were made for maps of districts to assist Collectors in district work, and in order to comply with this, Mr. Binnie, the Chief Surveyor, whilst working on the Anglo-Portuguese Provisional Boundary Delimitation in 1899 and 1900, surveyed as much country on either side of the boundary line as was possible in the time available, to a scale of 1 : 250,000.

"This work, although not altogether accurate, was much superior to previous information available, and was compiled with the Shire Highlands work, and some other detached surveys which had been made, and the whole published as a map of that part of the Protectorate from Central Angoniland to Chuonga, below Port Herald.

"(6) The first concerted scheme for mapping the Protectorate was started in 1903, when the Chief Surveyor, accompanied by two European Surveyors, commenced a comprehensive and systematic survey in the North Nyasa District, to a scale of

1 : 250,000. This work was started from the triangulated bases of the Anglo-German Nyasa-Tanganyika Boundary, information regarding which was supplied by the Director of Military Intelligence. During part of the season of 1903, the three Surveyors triangulated the hill peaks and plane-table surveyed the whole of the North Nyasa District as far south as latitude 11° S. Maps showing this work were published by the Intelligence Division of the War Office in two sheets, Songwe and Nyika Plateau.

"(7) Owing to pressure of work nothing was done in 1904, but during the present year, Mr. Firr, the first Surveyor, now on leave, carried the 1903 work south to latitude 12° 35′ S., with a section roughly 20 miles wide, the work being continued by Mr. Bannerman to latitude 14° S., in connection with the alignment of a trunk road between Dowa and Mzimba, which is now being made. The other Surveyor, Mr. Vaughan, is on leave, and work for 1905 is, for the present, suspended. It is, however, hoped that during the early portion of 1906 the unsurveyed portions between latitudes 11° and 14° S. and the West Coast of Lake Nyasa will be mapped, and maps showing the whole work published."

The Survey Department, in spite of its title, has been more occupied with engineering works and land duties than with surveys, and this explains the fact that the mapping of the Protectorate is in an incomplete state. In future the department will be called the Public Works Department, and miscellaneous survey duties will be carried out by a division of the department.

For the present, financial considerations prevent the execution of any systematic trigonometrical survey.

(ii.) Existing State of the Maps.

1. A map on the scale of $\frac{1}{1000000}$ of the whole Protectorate of British Central Africa, on one sheet, is now in course of preparation and will shortly be published.

2. $\frac{1}{250000}$, T.S.G.S., 2 sheets of the northern portion of British Central Africa, including the Anglo-German frontier and the Nyika Plateau, 1904; $\frac{1}{250000}$, T.S.G.S., 9 sheets of the southern portion, including the Anglo-Portuguese frontiers, Lake Shiswa, Zomba and Blantyre, 1901.

There is a gap between these two sets of sheets which should be filled as soon as possible.

3. Maps which are now somewhat out of date (*a*) Shire Highlands, on layer system, scale 5 miles to 1 inch, J. G. Bartholomew, 1897; (*b*) the Shire Highlands, D. L. Beringer, $\frac{1}{2}$ inch to 1 mile, E. Stanford, 1897.

(iii.) Natives as Surveyors.

Mr. Wallis, then Acting Commissioner, in a report written on the 10th October, 1905, states:—

"The training of natives in survey work has been attempted several times in this Protectorate with indifferent results; but although natives make accurate chain men, and are able to trace plans, they have utterly failed to grasp the principles of the most elementary surveying. A number are still undergoing a course of instruction, but except as chain men they are unsatisfactory. This may be accounted for by the total lack of ambition and want of sense of responsibility common to Central African natives. The future generation may improve in this respect, owing to the spread of education; it is, however, doubtful."

EAST AFRICA PROTECTORATE.

Commissioner	Lieutenant-Colonel J. Hayes-Sadler, C.B.
Director of Surveys	Captain G. E. Smith, R.E.
Assistant Director of Surveys...	Captain G. S. Knox, R.E.
Assistant Director of Surveys...	Mr. E. L. Waring.
Deputy-Assistant Director ...	Lieutenant E. W. Cox, R.E.

(i.) History of the Survey Department.

The present Survey Department was established in April, 1903, as a branch of the Public Works Department. The object of the department was described as being the "surveying plots in the neighbourhood of the railway zone." The staff then consisted of the Chief Surveyor and one Indian clerk, augmented a few months later by the addition of one European assistant. Simultaneously with the creation of the department the advantages of the country for settlement were widely advertised, causing a very large influx of prospective settlers, principally from South Africa.

The Chief Surveyor was in May of 1903 called to combine with his existing duties those of Land Officer. Since no survey existed, and it was imperatively necessary to settle the people on the land advertised as open for selection, every kind of makeshift had to be adopted to meet the situation.

The Chief Surveyor and Land Officer had at this time an entirely inadequate staff and was placed in an impossible position.

In 1904 the staff was augmented by the addition of six Europeans.

Outside surveyors were licensed, but as no framework existed, it was impossible to check their work.

The Chief Surveyor recommended in 1903 the execution of a trigonometrical survey; it is unfortunate that this recommendation was not at once acted upon. Much wasteful expenditure was incurred and the settlers had legitimate grievances against the Government.

In 1905 the Commissioner appointed a Land Commission to enquire into the whole question of land in the Protectorate. The Commission reported as follows:—

"The absence of survey has led from one difficulty to another. The land in some districts is said to have been applied for many times over, other districts partially settled have been closed for further settlement, other districts, again, have not been opened for settlement at all, and in no case is the Government able to proceed either with the work of getting rid of arrears of applications which have accumulated during the last two years or of turning its attention to the throwing open of uncultivated districts for settlement. As a consequence the general development of the country has received a severe check.

"The necessity of seriously and at once, dealing with the question of survey cannot be over-estimated. The present system of survey, if, indeed, it can be called a system, under which the Land Office require the making of plans of holdings, as all the surveyors themselves testified in their evidence, is both expensive and of comparatively little value. Isolated plans of holdings in different parts of the country are made which are not tied on to anything; and when a general and accurate survey comes to be made nearly the whole of the work will have to be done again."

In May, 1905, the Secretary of State for the Colonies directed Lieutenant-Colonel G. E. Smith of the Anglo-German Boundary Commission to investigate and report upon the surveys of the Protectorate.

In Colonel Smith's report, which is dated the 30th July, 1905, it is pointed out that the average time which elapsed between the date of application for a grant of land and the date of registry was 12·6 months, a delay which was a cause of considerable hardship to settlers of small means. With an adequate survey the formalities would be completed in a month.

Colonel Smith's report was of great service and formed the basis of a reorganisation of the department which was approved of on the 17th November, 1905.

(ii.) Organization of Survey Department in 1906.

The new organization dates from April, 1906.

The Land Department was separated from the Survey Department. Each is now an independent department. Captain G. E. Smith was appointed Director of Surveys. Mr. Barton Wright, formerly Chief Surveyor, was appointed Chief Land Officer.

The constitution of the Survey Department is as follows :—

Director of Surveys.

Clerk and Accountant.

Trigonometrical Party.	*Cadastral Party.*
Assistant Director.	Assistant Director.
1 Deputy Assistant.	6 European Surveyors.
2 European Surveyors.	1 Plan Examiner.
2 Indian Masons.	Licensed Surveyors.
3 Swaheli Fundis.	Subordinate Staff.

It is hoped shortly to form a

Topographical Party.

1 Assistant Director.
6 Non-Commissioned Officers.
4 Swaheli Fundis.

(iii.) Financial.

The present annual cost is—

	£
Director of Surveys	800
Clerk	250
Trigonometrical Party	3,293
Cadastral Party	8,256
	£12,599

The cost of the Topographical Party would be £3,321.

(iv.) Present State of the Maps.

The only accurate maps of the Protectorate are those of the Anglo-German Boundary zone, on a scale of $\frac{1}{100000}$ now under publication. There are 7 of these sheets, and the zone extends from Victoria Nyanza to Kilimanjaro, and from that mountain to Lake Jipe. The width of the zone surveyed is about 20 miles, and the work is excellent and accurate.

Of compilation maps there are the following :—

Scale $\frac{1}{1000000}$ 3 sheets, T.S.G.S.
„ $\frac{1}{250000}$ 15 „ „

(v.) General Remarks.

Whereas in the neighbouring protectorate, Uganda, the chief consideration is the land settlement of the natives, in East Africa it is the influx of white settlers which has necessitated a systematic land survey.

The process of organizing the survey on sound, methodical lines is now proceeding. It is hoped that in the next Annual Report, the Colonial Survey Committee will be able to show that substantial progress has been made in a work on which the future prosperity of the Protectorate so largely depends.

THE GAMBIA.

Governor ... Sir G. Denton, K.C.M.G.

The Gambia consists of a strip of territory about 185 miles long extending up the River Gambia from its mouth, enclosed north, south and east by French territory. The international frontier is defined principally by two parallels 26 minutes apart in the western portion, and in the eastern portion follows the river at a distance of 10 kilometres from the banks.

The Gambia has been sufficiently well mapped by the boundary commissions. A new edition of the boundary map is being produced and will shortly be issued.

THE GOLD COAST.

Governor	Sir JOHN RODGER, K.C.M.G.
Director of Surveys... ...	Major F. G. GUGGISBERG, R.E.
Assistant Director of Surveys	Capt. C. B. O. SYMONS, R.E.

(i.) Historical Sketch.
(ii.) Existing state of Surveys.
(iii.) Existing state of Maps.
(iv.) Organization.
(v.) Miscellaneous.
(vi.) Natives as Surveyors.
(vii.) Financial.
(viii.) General Result.
Diagrams.

(i.) HISTORICAL SKETCH.

A rigorous survey of the Gold Coast Colony was rendered necessary in 1901, on account of the large number of gold mining concessions taken up by companies. These concessions were, for the most part, indifferently demarcated by private surveyors, a great deal of overlapping of boundaries occurred and a considerable amount of litigation ensued.

In the middle of 1901, Major Watherston, R.E., brought out a small party of Royal Engineer officers, non-commissioned officers, and sappers, laid down several long traverse lines on which to base the survey of the concessions, and cut one or two concession boundaries, in order to obtain a basis on which to determine fair survey fees for boundary cutting.

In October, 1902, a large party of Royal Engineer officers and men, and Queensland and New Zealand surveyors, landed at Sekondi to undertake the survey of the concessions under Major Watherston, R.E., Director of Surveys.

During the three seasons, 1902–3, 1903–4, and 1904–5 upwards of 300 concessions were cut, and the country covered with a network of long traverses.

In 1903–4 Captain Guggisberg, R.E., with the Zenith Telescope, determined accurate latitudes at different points in the network. In 1904–5 Major Watherston determined the longitude of Accra by cable with Cape Town, and handed over the Directorship of the survey to Major Guggisberg.

In 1904–5, the survey of Ashanti concessions was started.

The nature of the Gold Coast Survey differs from that of the majority of other Surveys in Tropical Africa, owing to the

fact that the mining concessions necessitate the addition of a considerable amount of financial work to the ordinary technical work of a survey.

(ii.) Existing State of the Survey of the Country.

(*a*) The whole of the Gold Coast Colony and a part of Ashanti are covered with a network of traverses from 4° 45′ north to 6° 45′ north, and 1° 12′ east to 2° 47′ west.

(*b*) These traverses are rigidly surveyed with theodolite and steel tape. Their execution necessitated continual cutting through the forest, which covers the whole country, except that portion between Accra and the Volta River below about 6° 5′ north.

The legs of the traverses were necessarily short, owing to the dense tangled bush. The trees of the forest average about 180 feet in height, and the undergrowth runs up to about 60 feet. The labour of cutting kept the average length of legs at about 400 feet, though this varied locally accordingly to the nature of the country.

(*c*) At every three to five miles "Permanent Marks," with a distinguishing number, are erected to serve as beacons, and to preserve the azimuth observed at them.

(*d*) Angular measurements in the traverse are corrected at about every five to ten miles of traverse by observed azimuths.

From one to two seconds of arc per leg was about the average correction found to be necessary.

(*e*) Latitudes are observed with the Zenith telescope on Talcott's system at stations about 50 miles apart in latitude.

The comparison of astronomical and traverse differences of latitudes have shown, on the whole, excellent results. The following table shows some of the results :—

Place.	Astronomical Difference.	Traverse Difference.	Length of Traverse.
	° ′ ″	° ′ ″	
Kumase to Accra	1 08 37·1	1 08 36·1	190 miles.
Kumase to Prahsu	45 30·9	45 32·5	65 „
Kumase to Bibianiha	13 27·1	13 25·7	60 „
Sekondi to Accra	36 55·9	36 56·5	150 „
Axim to Tarkwa	25 58·9	25 59·0	45 „
Oponsu to Asankranqwa ...	06 45·9	06 46·2	70 „
Oponsu to Bibianiha	46 03·6	46 04·0	100 „
Axim to Asankagwa	56 36·2	56 33·8	130 „

THE GOLD COAST SURVEY.

CUTTING A LINE THROUGH THE BUSH.

(*f*) Measurements are further checked by closing the traverses, and the results of these closures form a further proof of the accuracy of the survey. One figure with a traversed perimeter of 320 miles closed to within 300 feet, or an error of $\frac{1}{5633}$, and generally the closing error proved to be between $\frac{1}{1000}$ and $\frac{1}{5000}$. This, in a country where everything in the shape of physical features and climate is against accuracy of work, may be taken as satisfactory.

(*g*) The dense nature of the country is against the trigonometrical determination of heights, as nowhere can a view be obtained of any importance, and but few hills exist of over 1,000 feet. Also, the necessity of pushing on the general survey as rapidly as possible, consistent with the accuracy of horizontal work, in order to allow the full strength of the survey staff being employed on concession work, (its *raison d'être*), has prevented any accurate levels being run.

A rough system of running the height through from the origin has been adopted, but the results have not been worked out.

This is the only point in which the survey can be said to compare unfavourably with that of other countries, but in view of the pressing necessity for making money, and also the nature of the country, the defect is comparatively unimportant, and can be remedied.

(*h*) Inside the network of traverse lines the detail of the country has been filled in chiefly by compass sketches fitted to fixed points on the rigid survey, but in certain parts the survey of the mining concessions has blocked in the areas between the traverses.

(iii.) Existing State of the Maps of the Colony.

The Survey came into existence in order to demarcate the many mining concessions for which leases had been taken out. The annual expenditure is large, but is partly balanced by the annual revenue, which is made up of the survey fees charged to companies for cutting their concession boundaries.

Owing, therefore, to the necessity not only of dealing rapidly with the accumulated mass of concessions which required urgent surveys, but also of making up the anticipated revenue, the whole of the available staff of surveyors were employed during the first three years in cutting concession boundaries and in surveying rigid transverse lines on which to base the concession surveys and obtain their relative position accurately. Consequently, only the topographical details of the country lying close to the work mentioned were obtainable in this period. In the last two years these conditions have become slightly modified,

but the map would still present greater blanks than it actually does had not the failure of so many Ashanti mining companies in 1904–5 permitted of the employment on topographical survey work of a large proportion of the staff brought out to demarcate their concessions.

The revenue naturally suffered by this, but the map gained, and a large amount of valuable information was obtained.

(*b.*) By 1904 an excellent framework for a map had been obtained, but when this was put together in the summer of that year it was obvious that, owing to the large tracts of still unexplored country, it would be unsound policy to attempt to bring out an expensive finished map when every additional month's work in the field would entail costly additions.

What material existed, however, was zinco-graphed and some provisional copies struck off. A further provisional issue in the same rough form was made in the summer of 1905, the scale being 1·014 inches to 4 miles ($\frac{1}{250000}$).

(*c.*) In 1904 Major Watherston produced a Map of Tarkwa and neighbourhood to meet the demand by Mining Companies who were naturally anxious to know where the numerous concessions in that district lay. The map had a bad sale. If produced two years earlier, when the West African Mining Boom was on, it would have had many purchasers. Unfortunately the lack of materials rendered its production then an impossibility.

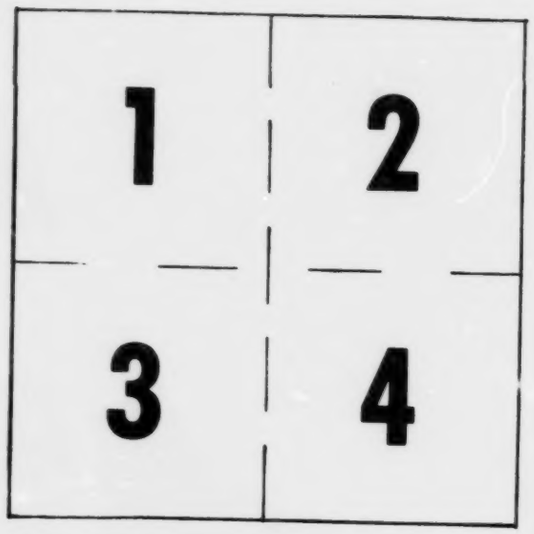
(*d.*) *General Scheme for the Maps of the Colony.*—As the Gold Coast Cadastral Survey is now drawing near its close, the accumulation of material and knowledge of exactly how much time remains for filling in the gaps on the map, have rendered it possible to draw up a general scheme.

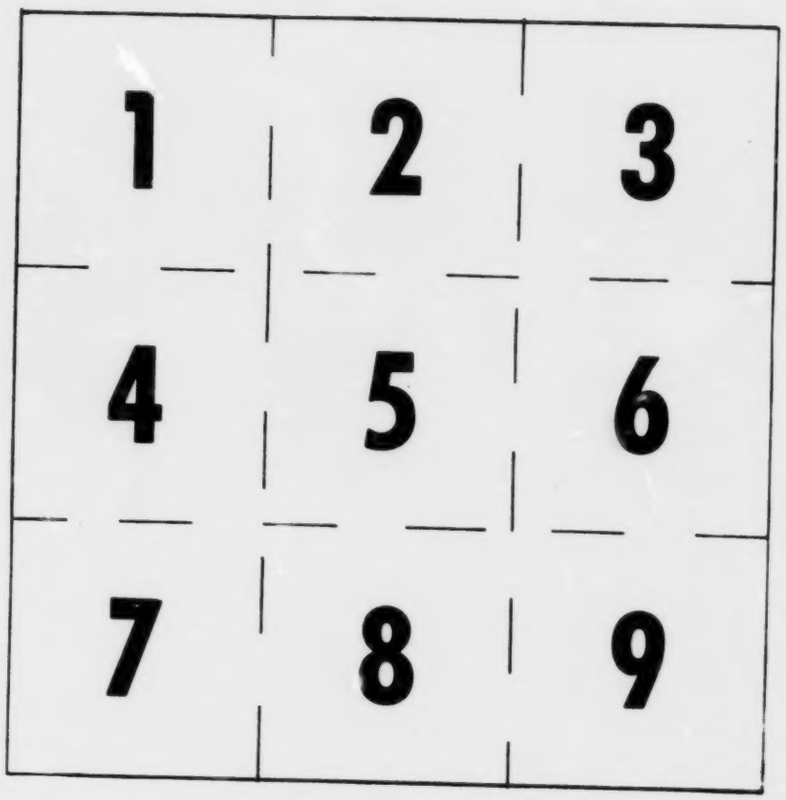
The $\frac{1}{125000}$ *Map* (1·014 *inches* = 2 *miles*).—This map will cover the Colony and Ashanti in 36 sheets, but owing to certain parts of the country to the north of Kumase being devoid of mining concessions and sparsely inhabited, it is considered that a map on such a large scale is not necessary for those regions.

These sheets are being produced entirely by the Gold Coast Survey, the drawing being done by the staff and the production paid for out of that portion of the Colony funds alloted to the vote on map production. Profits from the sale will go to the Colonial revenue. The map will be in four colours and will be the standard topographical map of the Gold Coast.

The $\frac{1}{250000}$ *map* (1·014 *inches* = 4 *miles*).—This map will be produced by the Topographical Section of the General Staff as part of their $\frac{1}{250000}$ Series of the general map of Africa. It will be in 9 sheets and will be founded on the material provided by the $\frac{1}{125000}$ sheets of the Gold Coast Survey.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





GOLD COAST

4°0′ 3°30′ 3°0′ 2°30′ 2°0′ 1°30′ 1°0′ 0°30′ 0°0′ 0°30′ 1°0′ 1°30′E 2°0′

8°N 7°30′ 7°0′ 6°30′ 6°0′ 5°30′ 5°0′

72-C-IV 72-D-I 72-D-II 72-D-III 72-D-IV 72-E-I 72-E-II 72-E-III 72-E-IV 72-F-I 72-F-II 72-F-III 72-F-IV 73-A 73-A-III

72-I-II 72-J-I 72-J-II 72-K-I 72-K-II 72-L-I 72-L-II 73-G

72-I-IV 72-J-III 72-J-IV 72-K-III 72-K-IV 72-L-III 72-L-IV 73-G-III 73-G-IV 73-H-III

72-O-II 72-P-I 72-P-II 72-Q-I 72-Q-II 72-R-I 72-R-II 73-M-I 73-M-II 73-N-I

72-O-IV 72-P-III 72-P-IV 72-Q-III 72-Q-IV 72-R-III 72-R-IV

72-V-I 72-V-II 72-W-I

Yeji
Kintampo
Sikassiko
Abease
Prang
Atabubu
Wiase
Krakye
Abrokono
Nkoranza
Bepekum
Odumase
Nkaneru
Akrosu
Asikaso
Bonaso
Mampon
Juaboahenang
Nkame
Debisu
Kumasi
Ageyo
Afiamso
Petroko
Adeamra
Bompata
Ahetife
Wopo
Alluakru
Asafo
Wiaowoso
Dadiaso
Oboase
Fumso
Asuom
Kyebi
Kofrodua
Akuse
Deodzĕ
Danoe
Enkyi
Asankagwo
Dunkwa
Nsuaim
Nsaba
Ada
Accra
Tanosu
Prestea
Tarkwa
Nianyano
Winneba
Cape Coast
Sekondi
Axim
Newtown
Allenda
Bonyere
Manso
Juhwa
Aguna
Elmina
Kommenda
Shenago
Ashiemee
Asuanang
Hemang
Para Jn.
Bunso
Mansang
Asamang
Okyeso
Esea
Tema
Pori
Prampram
Volta River
Afram River
Shawo River
Pra River
Ankobra River
Tano R.
Offin River
G.C. & E. Railway
Lake Bosumchwi

TOGOLAND

KEY PLAN
To the
GOLD COAST AND ASHANTI
MAP
1·125000 Series

KEY PLAN
To The
GOLD COAST AND ASHANTI
—MAP—
1·125000 Series

The Index Number of each sheet is given in the left hand top corner. The name of the sheet is given by the name of the Town printed in Roman small. Sheets lying West and East of the Meridian of Greenwich, belong to sheets 72 and 73 respectively of the 1·250000 series of the Map of Africa. Sheets darkened are ready for sale in four colours at 5/- per sheet. The natures of Roads Rivers and Towns are shown by symbols. All Concessions are shown.

F.G. GUGGISBERG.
Major R.E.
Director of Surveys

London
Sept. 13th 1906.

T.S.G.S., No. 2210.

War Office. Sept. 1906.

1:125,000 Sheets which will be published January 1907
1:125,000 " " " " June 1907

These sheets will replace the provisional sheets mentioned above.

(iv.) Organisation of the Survey.

(*a*) Season of work. Work in the field goes on during the dry season, from about the middle of October to the middle of June, though it is often much hindered by rain during the first and last fortnights in the river districts.

For the remainder of the year the survey party returns to England.

(*b*) The staff consists of the Director and one or two European draughtsmen, and one native draughtsman at headquarters at Accra, and of a varying number of survey parties in the field, depending on the amount of concession work there is to be done.

(*c*) Each party now consists of a surveyor, an assistant surveyor, an interpreter, two gangs, each of one headman and 18 carriers, and a gang of eight hammock boys.

The surveyor looks after the technical work and is responsible for the accuracy of his plans and figures. He has a responsible position to fill as it is often extremely difficult for him to ascertain the correct positions of concessions owing to the obtuseness of the chiefs and the usually very vague wording of leases. The surveyor is also responsible for the Government stores issued to him, and the payment of his men.

The assistant surveyor helps in the technical details of the work and oversees the cutting of the traverse legs.

(*d*) At headquarters the Director of Supplies superintends the movements of the parties in the field, and oversees the preparation of the Colony map and the numerous plans and sunprints of the concession surveys.

He conducts the correspondence of the office, chiefly with the secretariat, the Treasury, and the secretaries of mining companies. With regard to the last named, he has the arrangement of all survey details, corresponds direct with the companies, and is responsible for the recovery of his survey fees from them.

(*e*) At the end of the survey season all stores, tools, &c., requiring repairs are taken home, and the remainder stored in Sekondi and Accra. On arrival home, the surveyors go on leave, and the Director opens an office where arrangements are made with the mining companies for the coming season's work, all provisions for the parties are ordered, and the drafting of the map continued by the two draughtsmen allowed by the estimates, assisted occasionally by extra men when a pressure of work arises.

(*f*) At the end of September an advance party embarks for Sekondi, engages the gangs, and sorts the cases of stores and provisions.

When the main party arrive they find all their stores ready; stationery, cement, tools, provisions, &c., sorted, and they are able to take the field a day or two after landing.

When the last party has left Sekondi, fully outfitted for the whole season, and provided with a temporary depôt in the centre of the area allotted to it, the remainder of the stores are left in charge of the Transport Officer in Sekondi, and the Director and his draughtsmen proceed to Accra, where, owing to the drier nature of the climate, rendering drawing easier, and to the accessibility to the Secretariat and Treasury, headquarters of the survey has now been established.

(v.) Miscellaneous.

In addition to the current work of the survey a rigorous traverse was carried out by Captain Symons, R.E., up the Volta River from Kpong to Yeji. This traverse will fix the longitudes of the northern territories.

At the present moment (August, 1906), with the European staff all in England for the wet season, there are actually employed on the Gold Coast three native surveyors. One of these men has been entirely trained during the past year by the Department, the others had previous knowledge.

(vi.) Native Surveyors.

As regards the employment of natives as surveyors, Major Guggisberg reports:—"The exigencies of the survey have so far prevented any serious steps being taken to form a native school.

"During the last four years, however, several interpreters and other natives have acquired a fairly useful knowledge of measuring with the steel tape, chaining and prismatic compass work, levelling and centering theodolites, and ranging lines.

"Any attempt to pass these limits has generally been very disappointing in its result. It is a known fact that in order to become a really reliable surveyor, a man must be gifted with great application, and be able to devote himself to those many small details of his profession which result in accurate work. Such qualities are not unknown in the native of the Gold Coast, but they are far from common. It is, therefore, difficult to find suitable men.

"The case is not, however, altogether hopeless, and though want of time has prevented the necessary instruction being given in the past, there are now signs of an improvement in this respect. At the present moment there are several natives working as interpreters with parties, and receiving less pay than their education and standing entitles them to, on the understanding that the training they are undergoing in the general work, and the instruction they are receiving in spare moments from the surveyors, will sufficiently prepare them for more advanced instruction next year, and consequent advance of pay when they pass through the school.

"It is hoped that the lessening pressure of concession work will enable a small native school to be started at Survey Headquarters next season, which will result in the creation of a number of native surveyors of sufficient capacity to discharge survey duties in a country in which so many fixed points already exist."

(vii.) Financial.

From 1901 to 31st December, 1905, the total expenditure on the Gold Coast Survey amounted to £115,000. Of this £40,000 was recovered in survey fees, showing an average net annual expenditure of £18,750.

The net expenditure (excess of expenses over revenue) for 1906 is estimated as £10,000. In 1907 the net expenditure is estimated at £2,500.

(viii.) General Result.

At the end of 1907 the great bulk of the survey (cadastral and topographical) will have been completed, and the country will have been covered with a geographical framework of great accuracy and of a permanent character. From time to time revision of detail (an inexpensive process) will be required.

THE NORTHERN TERRITORIES,* GOLD COAST.

The Northern Territories of the Gold Coast form a Protectorate lying to the north of Ashanti between the parallels 8° and 11° North and the meridians 0° and 3° West of Greenwich. The area is 38,000 square miles.

* From information furnished by Major Watherston, C.M.G., Chief Commissioner.

Provisional maps of this area on a scale of $\frac{1}{250000}$ have been issued by the Topographical Section, General Staff, during the years 1905–06. These maps are based mainly on reconnaissance sketches of officers employed in the West African Frontier Force, which have been fitted on to a framework formed by the surveys made by the various Boundary Commissions that have demarcated the frontier, and a special piece of work done in 1904–05.

3. Two of these, the Northern and Western Boundaries, adjoining French territory, were surveyed with compass and chains and careful observations for latitude with a 5″ theodolite, and may be considered as second class work.

The Eastern boundary between the Northern Territories and Togoland was surveyed by rigid traverse and chain, a 5″ theodolite being used, and may be considered as first class work.

The Southern side of the framework was a piece of special work done by Capt. Des Voeux, R.E., in 1904-05, to connect the German boundary on the East to the French boundary on the West, and consisted of a rigid traverse from Salaga on the German Boundary Map to Bonduku on the French Boundary Map, and may be considered first class work.

4. Each of these Surveys included a belt of about 25 miles in breadth, in which all roads and towns were included, and on to this the sketches of the interior made by officers have been fitted with considerable success and accuracy.

5. A certain amount of the interior still remains to be sketched, and this is being carried on at the present moment, local tribal boundaries are being fixed, market towns registered, and hill features are being surveyed, and it is hoped that enough will have been done by the end of 1908 to render it advantageous to produce a revised copy of the map.

NORTHERN NIGERIA.

High Commissioner, Sir F. D. Lugard, K.C.M.G., C.B., D.S.O.

(i.) Existing State of Survey.
(ii.) Existing State of Maps.
(iii.) General Results.

(i.) Existing State of Surveys.

There is no survey department. The existing material is chiefly compiled from sketches made by civil and military officers while travelling on duty.

The frontiers of Northern Nigeria have been delimited as follows :—

The Western boundary by a mixed Anglo-French Commission in 1900. Major J. I. Lang (now Lang-Hyde) was British Commissioner.

The Northern boundary by a mixed Anglo-French Commission in 1902–04. Lt.-Colonel G. S. Mc D. Elliot, R.E., was British Commissioner.

The Eastern boundary by a mixed Anglo-German Commission in 1903–04. Lt.-Colonel L. C. Jackson, R.E., was British Commissioner.

The Northern boundary will shortly be surveyed again and beaconed by a mixed Commission, the frontier having been altered by international agreement.

A survey for a railway line from the River Niger to Kano was made in 1903–4.

A considerable amount of good compass traverse work, checked by observations for latitude, has been done, especially by Major J. A. Burdon, C.M.G., Mr. C. T. Temple, the late Captain Abadie, Lieutenant G. W. Denison, R.E., and by many others.

In 1905–6, an expedition, under Captain R. Ommanney, R.E., fixed, by interchange of telegraphic signals, the longitudes with reference to Lagos, of fifteen towns, *viz.*: Ibadan, Illorin, Jebba, Patigi, Lokoja, Zungeru, Kontagora, Yelwa, Zaria, Kano, Lere, Bauchi, Ibi, Keffi, Loko. The previous positions of Zaria, Lere and Bauchi were found to be 16 miles too much to the East; Zungeru was 8 miles wrong in the same direction. Loko and Keffi were 13 miles, and Ibi 22 miles too far west.

The published maps have all been compiled in the Topographical Section of the General Staff. This system of compiling maps at home does not lead to the best results, but owing to the non-existence of any local department it is the only method of producing any maps at all.

(ii.) The Existing State of the Maps.

Maps on the scale of $\frac{1}{1000000}$ and $\frac{1}{250000}$ covering the whole of Northern Nigeria have been published by the Topographical Section of the General Staff.

Those on the scale of $\frac{1}{1000000}$ are out of date, being based on the early work, and some 25 sheets of the $\frac{1}{250000}$ series are in want of total revision, in accordance with the results ascertained by Captain Ommanney's expedition.

(iii.) General Results.

The general result of the work of the last six years in the survey of Northern Nigeria are as follows:—

(1) The west, north, and east boundaries have been surveyed and delimited.

(2) The positions in latitude and longitude of some important towns in the interior have been determined.

(3) The collection of a mass of material varying from some excellent work to very rough road sketches, and the construction of compilation maps from this material.

SIERRA LEONE.

Governor, Leslie Probyn, Esq., C.M.G.

There is no survey department.

In 1904 the Colonial Survey Section under Captain H. D. Pearson, R.E., surveyed the neighbourhood of Freetown on the scale of one inch to one mile. This map embraces an area of 250 square miles; it is printed in four colours and is on sale. There is a general map of the Colony on the scale of $\frac{1}{1000000}$, compiled by the Topographical Section of the General Staff, from Boundary Commission maps and explorations. (T.S.G.S. 2,082).

There are also the regular sheets of the $\frac{1}{1000000}$ series (58, 59, 70, 71).

There are the sheets of the $\frac{1}{250000}$ series compiled from all available sources but not based on regular surveys (58 K, 58 O, 70 D, 59 I, 59 M, 71 A).

The frontiers between Sierra Leone and French territory, and Sierra Leone and Liberia have been completely demarcated, and maps of these frontiers are available.

In the present state of development of the Colony it is not considered necessary to spend money on a regular survey. It is desirable, however, that the civil and military officials of the Colony should fill up the gaps on the existing "compilation" maps as far as the time and means available permit.

SOUTH AFRICA.

1. The Survey Departments.
2. The Geodetic Triangulation.
3. Imperial Requirements.
4. The Survey Congress of 1904.
5. General State of the maps.
6. "Compilation" Maps.
7. Reconnaissance of the Cape Colony.
8. The Orange River Colony.
   - (i.) Origin of the Topographical Survey.
   - (ii.) Methods of Accuracy.
   - (iii.) Rate of Progress.
   - (iv.) Scales.
   - (v.) Financial.
   - (vi.) The Value of Co-operation.

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1. The Survey Departments.

The Colonial Survey Committee is not concerned with the surveys of the South African Colonies, except in so far as Imperial interests are involved. The Cape Colony, Natal, the Transvaal, and the Orange River Colony, have each a Survey Department, administered by a Surveyor-General. These Survey Departments are, in effect, land record departments. The farms are surveyed by licensed surveyors, and plans and records of the farms are kept in the Surveyor-General's Office. For purposes of land registration the system is an efficient one. The farm plans as a rule show only what is necessary for the definition of the property boundaries; each farm is surveyed independently. From the nature of the case little or no attention is paid to the delineation of the hill features.

At the meeting of the Surveyors-General, including the Surveyor-General of Rhodesia, held at Cape Town in March, 1904, and presided over by His Majesty's Astronomer, the qualifications and standard of examination for licensed surveyors were agreed upon.

2. The Geodetic Triangulation.

South Africa is covered with a geodetic triangulation of the first order. This triangulation was commenced in 1883. The Cape Colony and Natal were completed in 1892.

The triangulation of the Transvaal and Orange River Colony was commenced in 1903, the field work is now complete, and the computations of this part of the work will shortly be published.

In Rhodesia a chain of triangles extends along the meridian 30° E. to a point 200 miles north of the Zambesi. A gap in this chain between the River Limpopo and Gwelo is now being completed.

The conception and organisation of this magnificent work are entirely due to Sir David Gill, K.C.B., His Majesty's Astronomer at the Cape, and the execution and superintendence of it has been throughout in the hands of Colonel W. G. Morris, C.B.

The geodetic triangulation has cost about £180,000; not one penny of this has come from the pockets of the British taxpayer at home.

The colonies of South Africa are to be congratulated upon the foresight which prompted, and the ability and energy which rendered possible, the execution of this great framework, which ensures the accuracy of all future South African surveys, and which will eventually many times repay its cost.

3. Imperial Requirements.

The chief Imperial requirement is the provision of maps for the defence of the colonies. This matter has not been directly before the Colonial Survey Committee, and the information which follows has been furnished by the War Office.

4. The Survey Congress of 1904.

In February and March, 1904, a conference was held at Cape Town composed of Sir David Gill, President, a representative of the War Office, and the Surveyors-General of all the colonies of South Africa, including Rhodesia.

The object of the conference was the formulation of a scheme for the systematic topographical survey of the whole of South Africa.

A unanimous report was drawn up, but in the light of subsequent events it appears that the conference opened its mouth too wide. Some of the colonial governments found that the financial situation did not enable them to contribute the money required, and in May, 1905, the High Commissioner reported to the Secretary of State for the Colonies that the scheme must be regarded as indefinitely postponed.

Although the general scheme failed, the necessity of mapping South Africa has not been lost sight of. The general situation is as follows.

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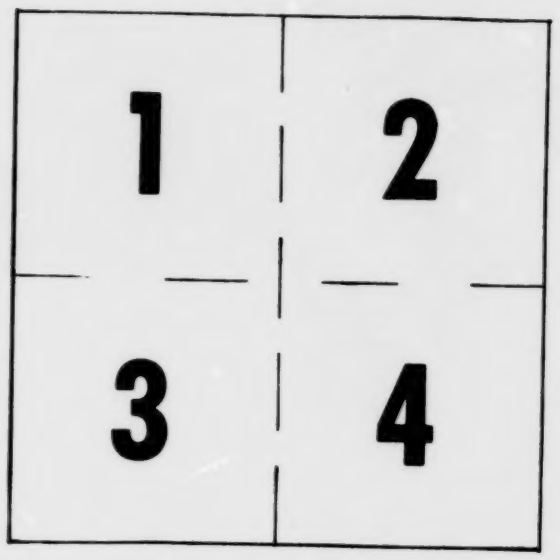

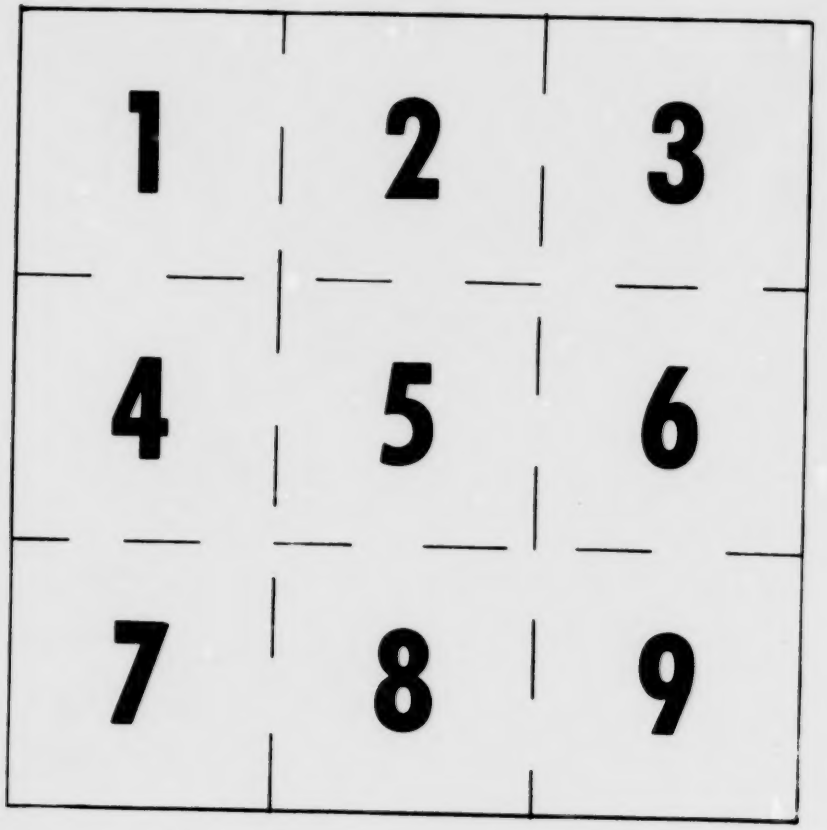

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to the sheets of

SOUTH AFRICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

Miles 50 0 50 100 150 200 Miles

REFERENCE

Work in progress
Finished sheets completed
Sheets published
Red names show names of sheets

The Sheets on the scale of $\frac{1}{125,000}$ are numbered thus 129-B III

GERMAN SOUTH WEST AFRICA

BECHUANALAND

ORANGE RIVER COLONY

TRANSVAAL

BASUTOLAND

NATAL

Tuli
Palapye
R. Lotsani
Louis Trichard
R. Letaba
Marabastad
R. Limpopo
R. Motowani
R. Pongola
R. Crocodile
R. Marico
Mochudi
Gaberones
Pienaars
Lydenburg
Belfast
Krugersdorp
Lichtenburg
Carolina
Bethal
Ermelo
Geysdorp
Vereeniging
Vryburg
Wolmaransstad
Wedefort
Heilbron
Volkrust
Taungs
Hoopstad
Lindley
Warrenton
Ventersburg
Newcastle
Dundee
Postmasburg
Campbell
Winburg
Ficksburg
Thlotse
Ladysmith
Jacobsdal
Maseru
Diep Fontein
Brakkies
Drachpender
De Wetsdorp
Wepener
Edenburg
Trompsburg
Bulwer
Richmond
Petrusville
De Aar
Colesberg
Matatiela
Clydesdale
Richtersveldt
Orange R.
Pella
Kakamas
Springbok
Boschluis
Groot Doorn Pan
Kop
Groot Vloer

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to the sheets of

TOPOGRAPHICA

les of 1/250,000 and 1/125,000

Scale 1/4,000,000

50 100 150

REFERENCE

in progress

sheets completed

s published

names show names of sheets

sheets in the scale of 1/125,000

numbered thus 129-B III

AL SURVEYS

200 Miles

20° 21° 22° 23° 24° 25° 26° 27° 28° 29° 30° 31° 32° 33°

22° 23° 24° 25° 26° 27° 28° 29° 30°

BEC

WEST

HUANALAND

ORANGE RIVER COLONY

TRANSVAAL

BASUTOLAND

SWAZILAND

ZULU LAND

NATAL

PORTUGUESE EAST AFRICA

Tuli

Palapye

R. Lotsani

R. Limpopo

R. Motwani

R. Crocodile

R. Marico

R. Elands

R. Magalakwin

R. Pongola

R. Olifants

R. Letaba

R. Klein Letaba

R. Sand

R. Pafuri

R. Luvuvhu

Louis Trichard

ZOUTPANSBERG 122-M

LEYDSDORP

Marabastad

P.P. Rust

Mochudi

Gaberones

OHRIGSTAD

Lydenburg

Pienaars

MACHADODORP

Belfast

Wilbank

Barberton

Kaapmuiden

Lourenço Marques

Krugersdorp

Lichtenburg

Carolina

Bethal

Ermelo

Vereeniging

Vredefort

Heilbron

Volkrust

Wakkerstroom

Piet Retief

Newcastle

Dundee

Vryheid

Ventersburg

Lindley

Winburg

Ficksburg

Thlotse

Ladysmith

Colenso

Greytown

Weston

Maseru

De Wetsdorp

Wepener

Matsieng

Mafeteng

Bulwer

Durban

Richmond

Clydesdale

Matatiela

Moyeni

Vryburg

Wolmaransstad

Taungs

Warrenton

Postmasburg

Paapkuil

Campbell

Jacobsdal

Diep Fontein

Drachpender

Brakkies

Petrusville

De Aar

Colesberg

Geysdorp

Hoopstad

Edenburg

Trompsburg

Groot Douwn Pan

Kakamas

Pella

Groot Vloer

Kopjes

R. Harts

R. Vaal

R. Orange

R. Brak

R. Hodder

R. Riet

R. Zand

R. Vet

R. Tugela

R. White Umfolozi

R. Umhlatuzi

R. Komati

R. Usutu

R. Pongola

R. Umzinyati

R. Ingwavuma

R. Ingwempisi

R. Phongolo

R. Buffalo

R. Klip

R. Wilge

R. Thabas

R. Caledon

R. Kraai

R. Kromme

R. Hart

R. Ongers

R. Molopo

R. Kuruman

R. Hotsé

R. Ngotwane

R. Notwane

R. Bonwapitse

R. Ramoutsa

R. Limpopo

R. Shashe

R. Tati

R. Ramaquabane

R. Mahalapye

R. Lotsane

R. Bamangwato

R. Motloutse

R. Shashani

R. Nata

R. Mahabe

R. Mahabe

R. Mahabe

ATLANTIC OCEAN

CAPE COLONY

BASUTOLAND

NATAL

CAPE TOWN

Orange R.

Gemsdal

Clanwilliam

Vredenburg

Saldanha B.

Hopefield

Bridgetown

Porterville

Tulbagh

Ceres

Wellington

Stellenbosch

French Hoek

Greytun

Simons Town

Cape of Good Hope

Walker B.

Malagas

Bredasdorp

C. Agulhas

Doornbosch

Olifants R.

Elands Vlei

Dams Laagte

Ernie Kuil

Steen Kamps Poort

Prince Albert

Klaarstroom

Calitzdorp

Gilles Ville

Hartbeest Kuil

Jansenville

Aberdeen

Uniondale

Avontuur

Haarlem

Blanco

George

Millwood

Hankey

C. St Francis

Alicedale

Bedford

Alice

King Williams Town

Alexandria

Port Alfred

Port Elizabeth

Great Kei R.

Steytlerville

Willowmore

Beaufort West

Graaff Reinet

Cradock

Somerset East

Pearston

Tarkastad

Whittlesea

Queenstown

Molteno

Stormberg

Slang River

Jamestown

Barkly East

Albert Jc

Burghersdorp

Aliwal North

Rhodes

Herschel

Stroom

Bethulie

Venterstad

Colesberg

De Aar

Petrusville

Trompsburg

Edenburg

De Wetsdorp

Wepener

Ficksburg

Thlotse

Ladysmith

Elandslaagte

Dundee

Newcastle

Vryheid

Utrecht

Wakkerstroom

Volksrust

Standerton

Heidelberg

Bethlehem

Harrismith

Van Reenen

Bergville

Estcourt

Weenen

Pietermaritzburg

Richmond

Clydesdale

Matatiele

Mount Ayliff

Mount Fletcher

Fletcherville

Maclear

Qumbu

Port St Johns

Umtata

Kokstad

Harding

Willowvale

Bolo

Clarkebury

Ugie

Maseru

Mafeteng

Matsieng

Butha Buthe

Leribe

Mohale's Hoek

Quthing

Mafeking

Vryburg

Kuruman

Griquatown

Campbell

Kheis

Prieska

Britstown

Carnarvon

Victoria West

Richmond

Middelburg

Murraysburg

Slang Fontein

Quagga's Pan

Hanover

Nauwpoort

Rosmead Jc

Steynsburg

Compass Berg

Sterkstroom

Lady Frere

Cathcart

Komgha

Butterworth

Idutywa

Kentani

Engcobo

Tsolo

Mount Frere

Kokstad

Umzimkulu

Port Shepstone

Umzinto

Durban

Pondoland

Griqualand

Transkei

Tembuland

Bechuanaland

Kalahari

Orange River Colony

Transvaal

Namaqualand

Little Namaqualand

Bushmanland

Karroo

Great Karroo

Little Karroo

Cape Flats

Table Mountain

Table Bay

False Bay

Hottentots Holland

Cape Peninsula

Cape of Good Hope

Agulhas Bank

Port Nolloth

Kamiesberg

Richtersveldt

Springbok

Boschluis

Gifberg

Piquetberg

Olifants R.

Doorn R.

Berg R.

Breede R.

Gouritz R.

Gamtoos R.

Sundays R.

Great Fish R.

Keiskamma R.

Buffalo R.

Tugela R.

Umzimkulu R.

Umtamvuna R.

Umkomaas R.

Umgeni R.

Umhlatuzana R.

Umlazi R.

Umbilo R.

Umkomazi R.

Umzimvubu R.

Umtata R.

Umtamvuna R.

Kei R.

Great Kei R.

Fish R.

Sunday's R.

Gamtoos R.

Gouritz R.

Olifants R.

Doorn R.

Berg R.

Breede R.

Orange R.

Vaal R.

Harts R.

Molopo R.

Kuruman R.

Nossob R.

Auob R.

Hex R.

Crocodile R.

Limpopo R.

Marico R.

Elands R.

Pongola R.

Buffalo R.

Tugela R.

Umzimkulu R.

Umtamvuna R.

Umkomaas R.

Umgeni R.

Umhlatuzana R.

Umlazi R.

Umbilo R.

Umkomazi R.

Umzimvubu R.

Umtata

Compiled in the Topographical Section, General Staff.

1906

AGENTS FOR THE SALE OF MAPS PUBLISHED BY THE TOPOGRAPHICAL SECTION, GENERAL STAFF.

LONDON	EDWARD STANFORD.	MANCHESTER	J. E. CORNISH.
EDINBURGH	JOHN MENZIES & Co.	GLASGOW	JOHN MENZIES & Co.
DUBLIN	HODGES, FIGGIS, & Co.	ALDERSHOT	GALE & POLDEN.
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Price One Shilling

HELIOZINCOGRAPHED AT THE ORDNANCE SURVEY OFFICE, SOUTHAMPTON, 1906.
October, 1906

5. General State of the Topographical Maps of South Africa.

The production of topographical maps is proceeding in the Cape Colony and in the Orange River Colony. The question of a topographical map of the Transvaal is still under discussion, and a correspondence is in progress on the subject of a map of Swaziland. A sketch of Basutoland is being carried out. Practically no topographical maps exist of Natal or Zululand, and no such maps are being produced.

6. Compilation Maps.

"Compilation" maps are those fitted together from farm surveys. Of this nature are the Cape Colony district maps and the following maps made during the war by the Field Intelligence Division:—the 4-mile "Imperial" map, initiated by Major Davies and Captain Kirkpatrick and produced by Messrs. Wood and Oertlepp, and the "Degree Sheets" of the Orange River Colony and the Transvaal on the scale of 2·37 miles to 1 inch, produced under the superintendence of Colonel H. M. Jackson, A.A.G. for Topography. These compilations serve to give the farm names, but are misleading as regards the hill features.

7. The Reconnaissance of the Cape Colony.

Five officers seconded from regimental duty, and six other officers who are detached for the purpose from their regiments (except during the training season), are employed in carrying out the reconnaissance of the Cape Colony. Captain C. G. W. Hunter (Staff Captain, Head-Quarters Staff), is in charge of this work.

The reconnaissance sketches are based on the geodetic triangulation of the Colony. Extending from this, a graphic triangulation is carried out, and the sketching is plane-table work dependent on the points so fixed. It is hoped that it will be possible in the future to strengthen this at intervals by some rapidly executed instrumental chains. The results will not be all that a geographer might desire, but they will be a good deal better than any maps which exist at present. Thanks to the geodetic framework no serious accumulation of error is possible. The work in the field and in the office was inspected in 1905 by Colonel H. M. Jackson, R.E., who reported on the whole favourably. The inspecting officer made certain suggestions which were approved by the General Officer Commanding in Chief, and, as far as possible, have been carried out.

The reconnaissance is progressing at the rate of about 20,000 square miles a year. The accompanying diagram shows the progress made up to date (August, 1906).

8. The Orange River Colony.

(i.) *Origin of the Topographical Survey.*

The Topographical Survey of the Orange River Colony is being carried out by the Colonial Survey Section as the result of an arrangement between the War Office and the Colonial Government.

In September, 1905, the Section, consisting of two officers and four non-commissioned officers, left England. The officer commanding the Section is Captain L. C. Jackson, R.E. Work was commenced in October in the neighbourhood of Kroonstad and is being systematically prosecuted sheet by sheet. It is anticipated that the survey of the whole Colony, which has an area of about 47,000 square miles, will be completed in 5½ years, and that by about the summer of 1911 all the sheets will have been published.

(ii.) *Methods and Accuracy.*

The survey is based upon the geodetic triangulation. This is being broken up into a secondary triangulation, of which the sides average about 8 miles. In the work so far completed the average triangular error of the secondary triangulation is 3·54 seconds. In a length of 60 miles the linear errors generated, as tested by the geodetic triangulation, were, in latitude, 0″·01, and in longitude less than 0″·06, *i.e.*, a total displacement of 6 feet, showing a satisfactory degree of accuracy.

The secondary points are plotted on plane-tables and the detail survey is carried out entirely by rigorous plane-tabling. All the heights depend on the geodetic values.

(iii.) *Rate of Progress.*

The average out-turn of work for each working day has been 8·07 square miles per plane-tabler. For the whole party, and including non-working days, the average daily output is 21·84 square miles. The area surveyed up to the 20th July, 1906, is shown on the accompanying diagram. These results reflect great credit on the officer commanding the section and on those under his orders, especially in view of the fact that the portion of the country at present being surveyed is not an easy one for a plane-tabler.

(iv.) *Scales of the Survey.*

The scale of the survey is ½ inch to 1 mile. In the first instance the survey will be published on the $\frac{1}{125000}$ scale, subsequently also on the scale of $\frac{1}{250000}$.

(v.) *Financial.*

The estimated annual cost of the survey is £3,369, and the total cost £18,500; of this the Orange River Colony contributes £9,000, and the rest is charged to Army votes.

(vi.) *The Value of Co-operation.*

The Surveyor-General and the officer commanding the Colonial Survey Section have discussed the question of the information required for civil purposes, and have come to an agreement on the subject. Throughout the negotiations the Government of the Colony has met the War Office in a very friendly spirit. The Colonial Survey Committee have been requested to take this opportunity of expressing the thanks of the Army Council to the Surveyor-General for the assistance which he has rendered to the Colonial Survey Section.

Like the other South African Colonies, the Orange River Colony is possessed of a first-class geodetic triangulation and has an efficient system of farm survey and land registration. If to these is added the excellent topographical survey above described, it will be seen that the position of this Colony is, in respect of surveys, superior to that of any other British Colony or Protectorate in Africa.

SOUTHERN NIGERIA.

[LAGOS AND SOUTHERN NIGERIA.]

Governor ... ... Sir WALTER EGERTON, K.C.M.G.

Director of Surveys ... ... Mr. E. P. COTTON.

(i.) Historical Sketch.
(ii.) Existing State of Surveys.
(iii.) Existing State of Maps.
(iv.) Organization.
(v.) Natives as Surveyors.
(vi.) Financial.
(vii.) General Result.

Lagos (now Western Province of Southern Nigeria).*

(i.) Historical Sketch.

Between January, 1901, and January, 1906, the constitution and functions of the Survey Department remained much the same. But in the earlier years many of the staff had little professional knowledge, and it devolved upon the Commissioner of Lands, Mr. E. P. Cotton, to train the personnel.

During these years also much time was devoted to the carrying out of accurate theodolite traverses; up to December, 1904, 800 linear miles of such traverses had been completed. The error of closure was never greater than $\frac{1}{2000}$.

In 1904 the longitude of the transit instrument of the observatory at Lagos was determined by exchange of telegraphic signals with the Royal Observatory at the Cape of Good Hope. The results showed a high degree of accuracy.

In 1905 the boundary of the Egba territory was surveyed and marked. In 1905 and 1906 780 miles of fresh traverse work was carried out.

Not much cadastral work has been required, but from time to time miscellaneous cadastral plans have been produced.

(ii.) Existing State of the Surveys.

The longitude of the fundamental point (the observatory at Lagos) has been determined.

About 1,580 linear miles of theodolite traverse have been completed, forming an accurate framework on which to base the map of Lagos (now the Western province of Southern Nigeria).

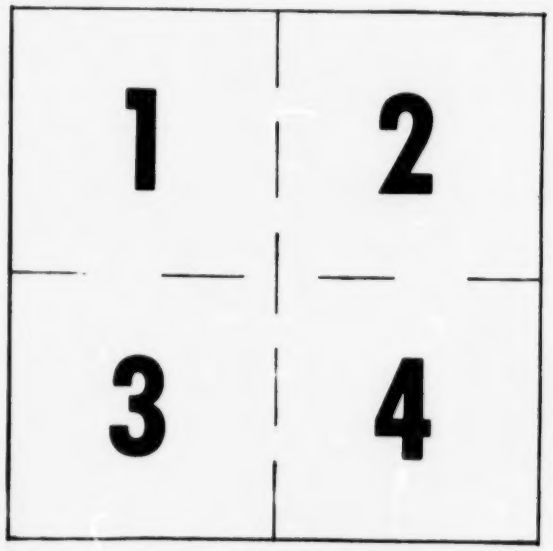
The Egba boundary has been marked.

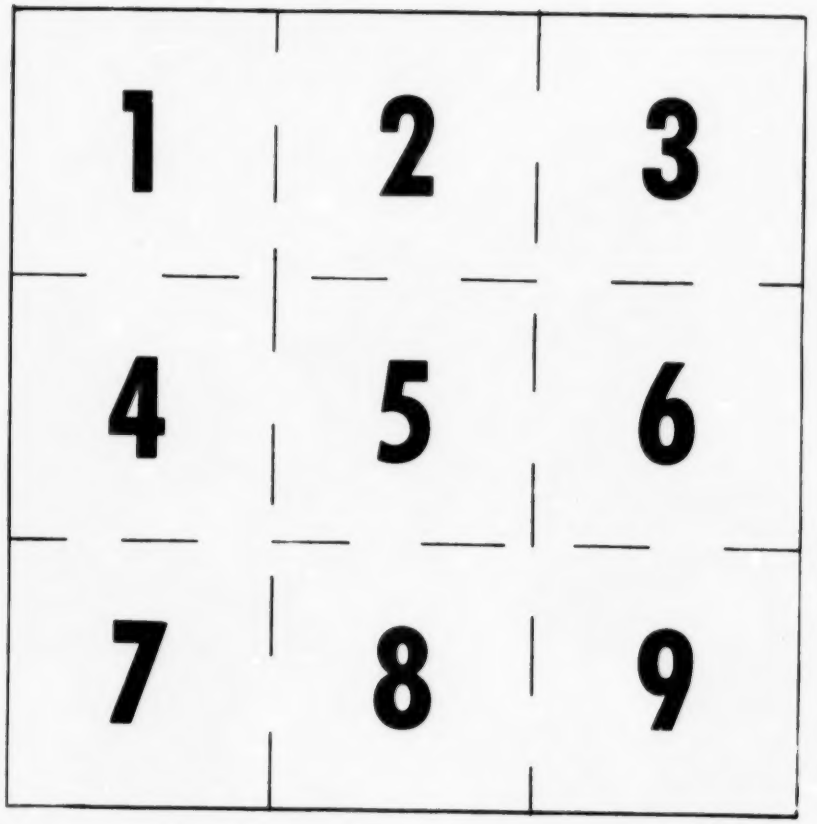
Miscellaneous cadastral surveys have been carried out in or near the Island of Lagos.

It is also to be noted that in 1905-06 Captain Ommanney's expedition on the way to Northern Nigeria determined telegraphically the longitudes of Ibadan and Illorin.

* As the amalgamation of Lagos and Southern Nigeria was only carried out on the 1st of May, 1906, it is convenient for the purposes of this publication, to deal with the territories separately.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.

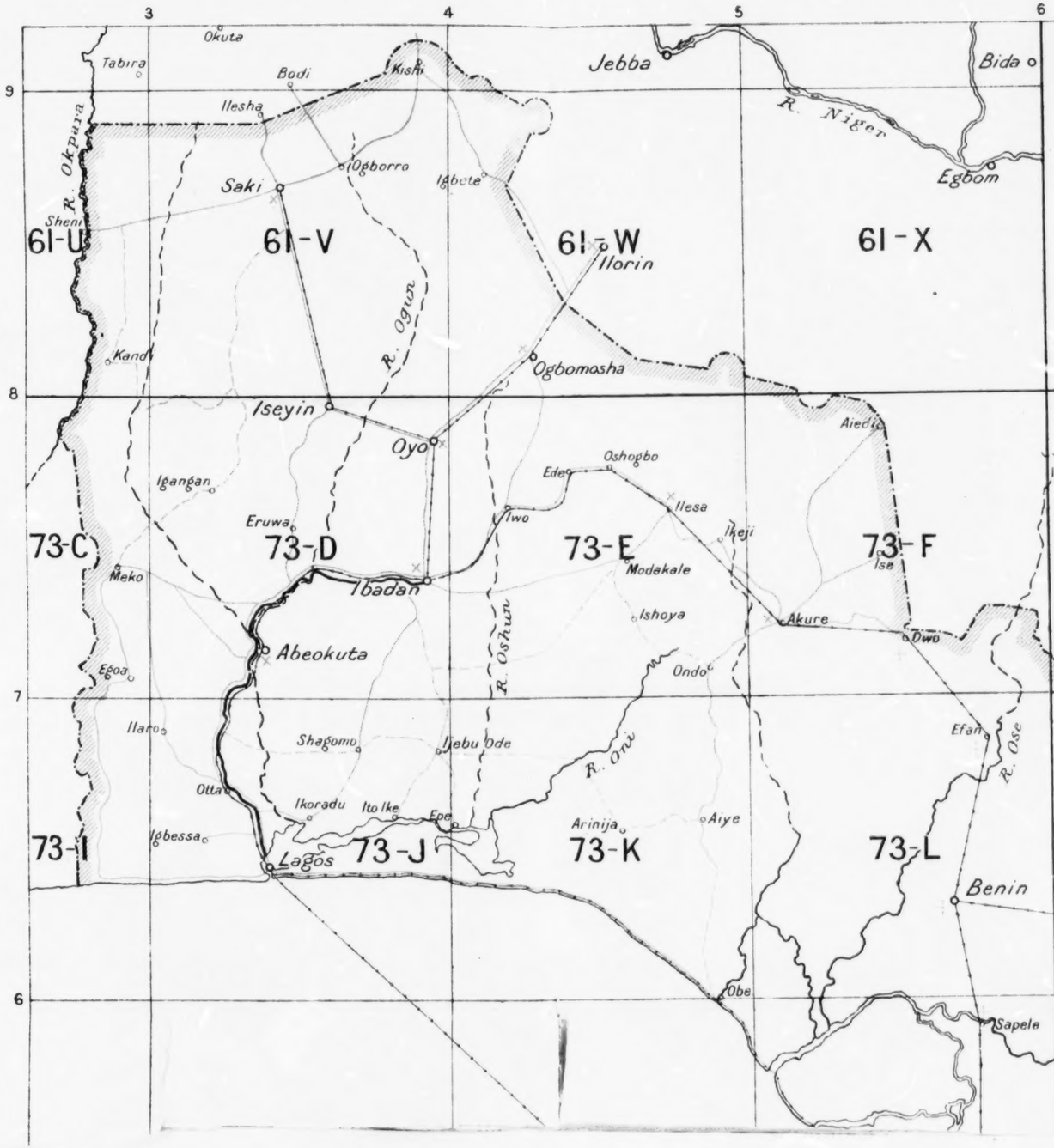




INDEX TO THE 1 : 250,000 SURVEY OF SOUTHERN NIGERIA

Scale - 1/2,000,000 or 1·014 Inches to 32 Miles

Miles 50 40 30 20 10 0 50 100 Miles



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TO THE
1 : 250,000 SURVEY
OF
SOUTHERN NIGERIA

Scale - 2,000,000 or 1·014 Inches to 32 Miles

Miles 50 40 30 20 10 0 50 100 Miles

4 5 6 7 8 9 10

9 8 7 6

61-W 61-X

73-E 73-F 73-J 73-K 73-L

74-A 74-B 74-C 74-D 74-E 74-G 74-H 74-I 74-J 74-K 74-P 74-Q

Jebba
Bida
R. Niger
Egbom
Abete
Ilorin
R. Ogun
Ogbomosha
Oyo
Aiedi
Oshogbo
Eder
Ilesa
Iwo
Ikeji
Modakale
Ishoya
Akure
Ise
Owo
Ondo
R. Oshun
R. Onu
Ijebu Ode
Ike
Epe
Arinija
Aiye
Efan
R. Ose
Benin
Asaba
Obe
Sapele
Abo
R. Niger
Lokoja
R. Benue
R. Katsena
Cross R.

73-C
73-D
73-E
73-F
74-A
74-B
74-C
73-I
73-J
73-K
73-L
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74-H
74-I
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Igangan
Eruwa
Oshogbo
Ede
Ilesa
Iwo
Ikeji
Meko
Ibadan
Modakale
Ise
Lokoja
Ishoya
Akure
Owo
Abeokuta
R. Oshun
Egoa
Cndo
Ilaro
Shagomo
Ijebu Ode
R. Ore
Efan
R. Ose
Otta
Ikoradu
Ito Ike
Epe
Arinija
Aiye
Igbessa
Lagos
Benin
Asaba
Cross R.
Obe
Sapele
R. Niger
Abo
Wari
R. Forcados
Calabar
Eket
Bonny
Akassa
Brass

Theodolite traverses completed
Longitudes fixed by telegraph lines
Telegraph in hand 06-07 edged
Work in hand 06-07 edged
Longitudes to be fixed in 06-07
Additional Theodolite traverses

3 4 5 6 7 8 9
7 6 5 4

T.S. No. 2221

Oyo
Oshogbo
Ede
Ilesa
Iwo
Ikeji
Ibadan
Modakale
Ishoya
Akure
Ondo
Ife
Ijebu Ode
Ito Ike
Eve
Arinija
Aiye
Benin
Asaba
Obe
Sapele
Abo
Lokoja
Wari
R. Oshun
R. Oni
R. Ose
R. Niger
R. Forcados
R. Katsena
Cross R.
Calabar
Eket
Bonny
Akassa
Brass

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74-V
74-W

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traverses completed
fixed by telegraph
nes
nd 06-07 edged
to be fixed in 06-07
Theodolite traverses

War Office, Sept 1906

(iii.) Existing State of the Maps.

The Survey Department has not yet produced any topographical maps of Lagos.

The following compilation maps exist :—

Lagos and Southern Nigeria, $\frac{1}{1000000}$, two sheets, T.S.G.S., 73 and 74.

Lagos and Southern Nigeria, $\frac{1}{250000}$, 19 sheets, T.S.G.S.

The latter sheets will be superseded on the issue of maps to be produced by the department.

(iv.) Organization (Lagos).

Hitherto, the post of Colonial Surveyor and that of Commissioner of Crown Lands has been held by one officer and the composition of the department has been :—

Commissioner of Lands.
5 European surveyors
6 Native surveyors and draughtsmen.
4 Native pupils.

The Survey and Lands Departments have now been separated, and a new Survey Department is in process of organization for the whole (amalgamated) Colony and Protectorate. The proposed European establishment is, a Director, an Assistant Director, five surveyors and a draughtsman.

(v.) Natives as Surveyors.

The Commissioner of Lands has rightly directed much attention towards training natives of the country as surveyors, and has been successful in his methods. He reports that he adopted ordinary methods of teaching drawing, "and the results obtained were quite as good as might have been expected had these young men been fairly educated Europeans." "These young men now thoroughly understand lettering, colouring, plotting by co-ordinates and with protractor, conical projection, the method of checking long traverses . . . the use of the eidograph, arithmometer, and the usual methods of reduction and transfer."

With regard to out-door work, those who have been trained in surveying have done equally well, they can, "quite efficiently, take latitude and obtain true bearing." Their observations have been checked, "and the average error was . . . under fifteen seconds of arc."

"The native requires dealing with with a firm and steady hand . . . . and should not be trusted with money. I am of opinion that the best results would be obtained by classifying them into special departments for which they are best suited, and placing them under thoroughly good European officials."

It is satisfactory to be able to record this successful attempt to employ natives.

(vi.) Financial.

The cost of the Survey Department for the year ending the 31st March, 1906, was £4,623.

(vii.) General Result.

The major framework of Lagos is practically complete, it is now essential that the filling in of the detail should be proceeded with systematically.

The experience of the Survey Department of Lagos shows that it is possible to train natives to become efficient surveyors.

Southern Nigeria.

(i.) Historical Sketch.

A small Survey Department was formed in March, 1901, consisting of two R.E. officers, one native surveyor, and one clerk. The Superintendent of Surveys, up to the date of amalgamation of the department with that of Lagos, was Captain A. J. Woodroffe, R.E. From April to June, 1901, the party was employed on the survey of a route for a telegraph line from Bonny to Calabar. From November, 1901, to May, 1902, the party was similarly employed between Ogbo and Forcados. During the latter part of the same period the officers were employed in a military capacity with the Aro Field Force, and in fixing the boundary between Northern and Southern Nigeria.

From November, 1902, to January, 1903, geographical positions were fixed on the Kwa River.

January, 1903, to May, 1903, the party erected the telegraph line from Ogbo to Forcados, and from November, 1903, to May, 1904, the party was similarly employed between Bonny and Calabar.

From November, 1904, to June, 1905, positions were fixed on the Cross River, the Oban Hills were triangulated, and compass traverses were made of the country to the north of Abokam.

From November, 1905, to present date, August, 1906, the party has been employed upon the Anglo-German (Southern Nigeria-Kamerun) Boundary.

It will be seen that the work carried out during the past five years has been of a very miscellaneous character. Some good geographical work has been done, notably the triangulation of the Oban region, but the custom of detaching the party for non-geographical duties, convenient as it may be at the time, has the serious drawback that the execution of anything like a systematic scheme becomes impossible. In fact, no systematic progress has been made and the mapping of Southern Nigeria has yet to be seriously undertaken. Piecemeal, irregular work is expensive in the long run and should not be permitted in the future.

(ii.) Existing State of the Surveys.

A triangulation, which covers an area of about 2,000 square miles, has been carried out in the Oban Hills. This is connected with Calabar by latitude and azimuth, and the longitude of Calabar has been fixed chronometrically from Bonny.

The astronomical positions of fifty important places have been determined; the longitude by chronometrical differences based on Bonny.

The Anglo-German Boundary zone comprising an area of 810 square miles has been topographically surveyed.

Admiralty surveys have been carried out (chiefly by Commander Learmonth, R.N.) of—

The Cross River estuary and part of the Calabar River, part of Opobo River, Bonny and New Calabar River, Warri and Benin River, Niger River entrance, Brass River, Port Forcados.

(iii.) Existing State of the Maps.

Maps available:—

Southern Nigeria and Lagos, scale $\frac{1}{1000000}$, one sheet, T.S.G.S.

Southern Nigeria, scale $\frac{1}{500000}$, one sheet (Southern Nigeria Survey Department).

Southern Nigeria-Kamerun boundary zone, scale $\frac{1}{100000}$ (in preparation).

(iv.) Organization.

See above, under "Organisation" (Lagos).

(v.) Financial.

The average annual cost of the department from 1901 to 1905 was £2,200.

The estimated expenditure for 1905–1906 was £2,608, but on account of the delimitation of the Anglo-German boundary this will be slightly modified.

(vi.) General Result.

(*a.*) Telegraph lines have been erected from Ogbo to Forcados and from Bonny to Calabar. (Not legitimate work for a survey department.)

(*b.*) Fifty astronomical positions have been fixed, and a map based on these has been published on a scale of $\frac{1}{500000}$.

(*c*) The Anglo-German frontier for a length of 140 miles from the mouth of the Akpaiyefé River has been demarcated.

(*d.*) Material exists for a map of the Oban country.

UGANDA.

Commissioner ... ... Mr. Hesketh Bell, C.M.G.
Director of Surveys ... ... Mr. R. C. Allen.
Assistant Director of Surveys Mr. W. V. Morris.

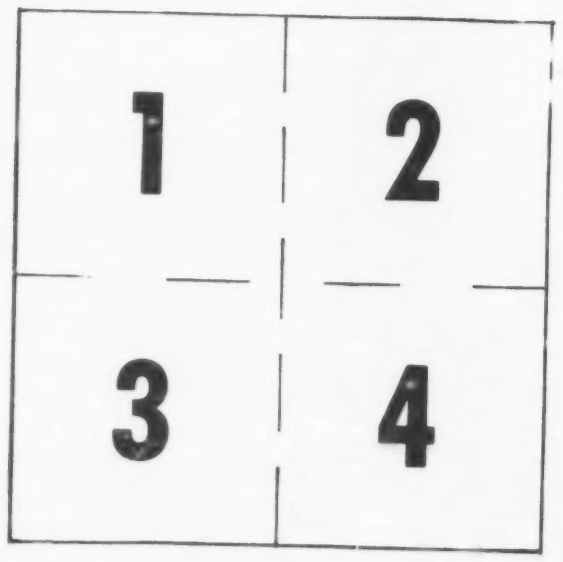
(i.) Necessity for Surveys.
(ii.) Existing State of the Surveys.
(iii.) Existing State of the Maps.
(iv.) Organization.
(v.) Natives as Surveyors.
(vi.) Financial.
(vii.) General Remarks.
(viii.) Difficulties of Survey work in Africa.

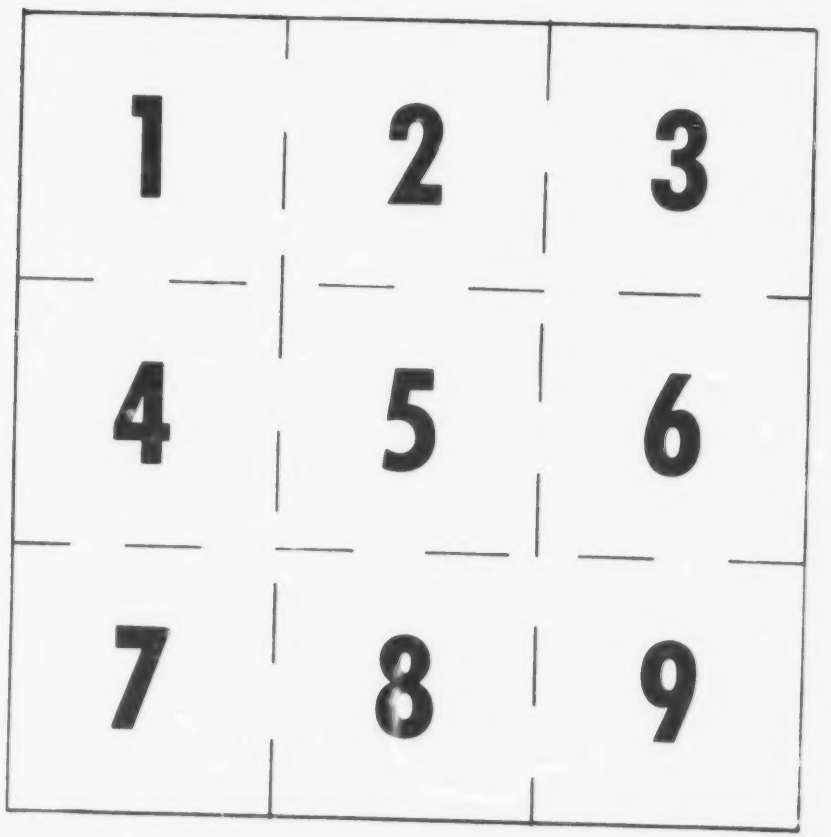
(i.) Necessity for Surveys.

The Survey Department of Uganda is entrusted with the execution of the following duties :—

The production of a Topographical Map for administrative purposes on the scale of $\frac{1}{125000}$, and the production of cadastral plans of the "Kingdom of Uganda" on the scale of $\frac{1}{10560}$.

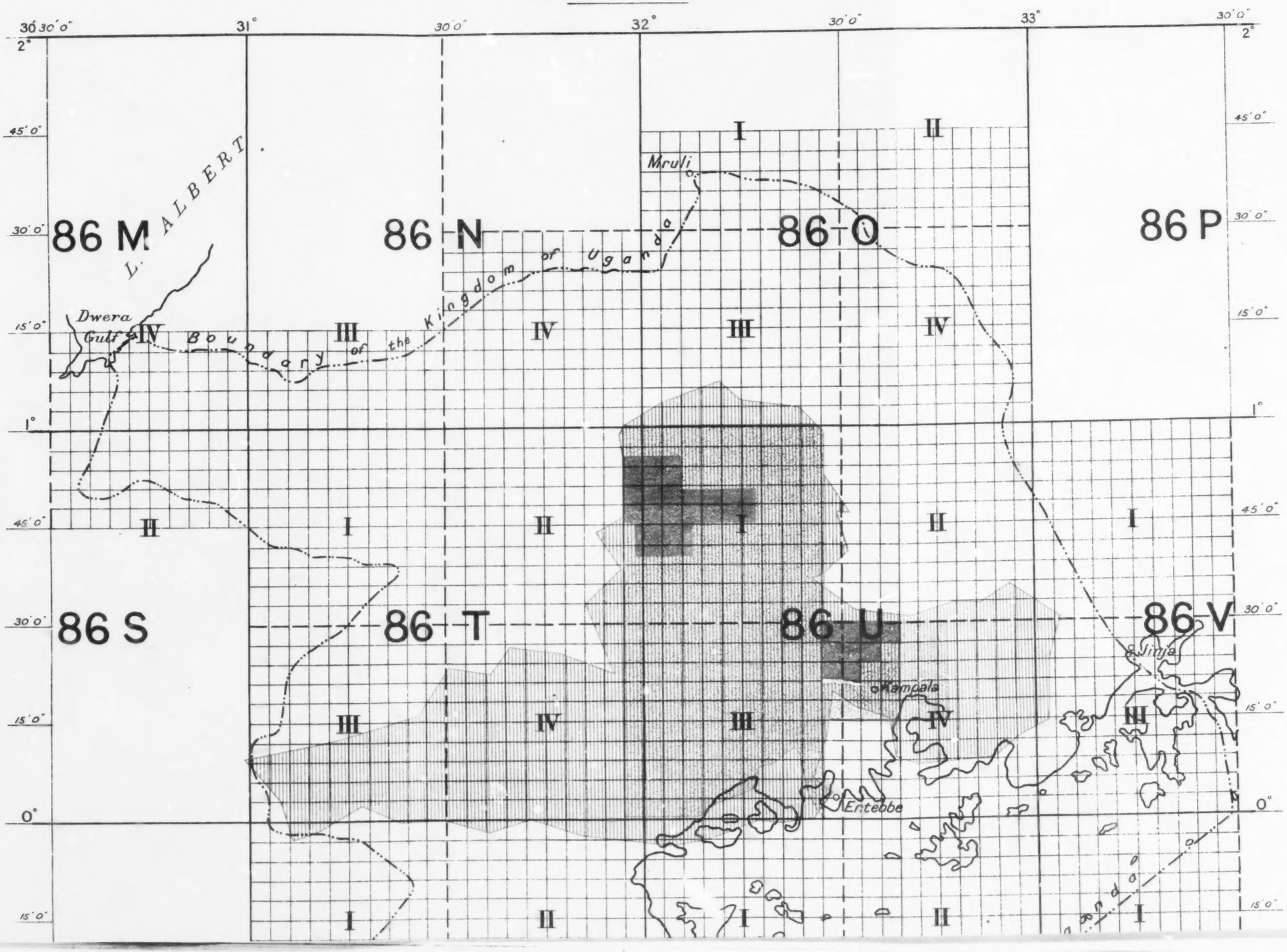
Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





KINGDOM OF UGANDA

INDEX PLAN



86 S

86 T

86 U

86 V

93 A

93 B

93 C

93 D

Jinja

Kampala

Entebbe

Masaka

Sesse I.

L A K E V I C T O R I A

Boundary of the Kingdom of Uganda

45' 0"

30' 0"

15' 0"

0°

1°

30° 30' 30"

31°

32°

33°

I

II

III

IV

Scale 1/1267200 or 1" – 20 Miles

REFERENCE

Area over which observations have been completed with Theodolite for the 1/63360 Survey

Area in which the Field Sheets for the 1/253440 Scale have been completed.

Area in which the Field Sheets for the 1/63360 Scale have been completed.

T.S.G.S. N° 2223 B

War Office. Sept 1906.

The latter are required for the allotment of estates to chiefs and landowners in accordance with the Uganda Agreement of 1900. These estates, aggregating some 9,100 square miles, are scattered about all over the kingdom, and until they are demarcated and the areas to which each chief and landowner is entitled are definitely settled, it is not possible to know which lands are Crown lands and which the property of the natives. It is also necessary to define the Crown forests of the Protectorate.

The Survey Department was put on a proper footing in order to allay the feeling of unrest throughout the country on the subject of land. Each landowner has in the meanwhile been given a preliminary certificate admitting his claim, subject to rectification by the survey.

The Commissioner of Uganda reports that he looks upon "this mapping of the estates and the eventual settlement of the land question as the main factor in the peace and development of the country."

The Chief Surveyor of Uganda estimates that the area which it is necessary to survey on the $\frac{1}{10000}$ scale is 15,150 square miles.

(ii.) Existing State of Surveys.

Approximately 3,000 square miles have been surveyed up to August, 1906, on the scale of ½ inch to 1 mile (this will be reproduced on the $\frac{1}{125000}$ scale).

Of the large scale cadastral survey on the scale of $\frac{1}{10000}$ about 400 square miles has been completed.

Points for the main triangulation have been selected and beacons fixed over an area of 13,630 square miles. The total area beaconed for the secondary triangulation is 11,550 square miles.

The area of main triangulation completed is 4,660 square miles; the area of secondary triangulation completed is 5,060 square miles. The average triangular error of the main triangulation is 4·95″; the average triangular error of the tertiary triangulation is 7·40″. The sides of the former average 13·6 miles and of the latter 7·4 miles.

Along the whole of the northern shore of Victoria Nyanza extends the triangulation carried out in 1904, by the Anglo-German Boundary Commission under Lieut.-Colonel C. Delmé-Radcliffe. The triangular error of this is 6″, and the average length of the sides 15 miles. The longitude of the survey at present depends on that of the observatory pillar near

the telegraph office, Port Florence. This was determined telegraphically from Mombasa by the above-mentioned Commission in 1902.

There now exists an unbroken chain of triangles from the north-eastern shores of Lake Albert Edward at Kasinga to Sir David Gill's longitude point at the British Consulate at Zanzibar. The chain extends from Kasinga towards the intersection of Lat. 1° S. and Long. 30° E. of Greenwich, then along the Anglo-German boundary on the British side to Lake Victoria. From here the chain passes by the northern shores of the Lake to Port Florence and from there southwards as far as the Anglo-German frontier on the east shore of the Lake; after this the triangulation passes through British territory on the northern side of the boundary past Mt. Kilimanjaro as far as the south end of Lake Jipé. From here the series extends to join the German Government Usambara triangulation, the southern points of which were used by the Anglo-German Boundary Commission to make the connection with Zanzibar in 1905. The calculation of this chain will shortly be completed and will supply points of precision from the Indian Ocean to the Congo Free State.

The longitudes determined by this measurement will then supersede the telegraphic determination on which the Uganda Survey at present depends.

(iii.) Existing State of Maps.

The following maps exist :—

$\frac{1}{1000000}$, 1 sheet (No. 86), T.S.G.S.

$\frac{1}{250000}$, 16 sheets, provisional, T.S.G.S. These are based on sketches and will be superseded by the results of the survey.

$\frac{1}{100000}$, 3 sheets, Anglo-German Boundary Commission, west of the lake.

During the ensuing year the first sheets of the systematic survey will be published.

(iv.) Organization.

In July, 1905, the Survey Department consisted of :—

One chief surveyor (Mr. R. C. Allen).
One assistant surveyor.
Ten European surveyors.
One Indian surveyor.
Nine Indian plane-tablers and draughtsmen.

Of the Indian surveyors, Mr. Wahid Ali Khan has done excellent work. One Indian plane-tabler was invalided in March, 1905; the other Indian plane-tablers did not turn out very well, and steps are being taken to replace them by Europeans.

(v.) Natives as Surveyors.

The Chief Surveyor reports as follows:—"The natives of the Protectorate are employed as chainmen and for the ranging out of straight lines, &c., but are still in much too backward a stage of civilisation to be employed on any real survey work such as plane-tabling."

In the opinion of the Colonial Survey Committee, however, a beginning should be made in the employment of natives as surveyors. This may be effected in three ways, either by the formation of a school in Uganda, or by sending Uganda natives to study on the West Coast, or by the importation of a nucleus of West Coast natives.

(vi.) Financial.

The estimated expenditure for the year 1905–06 was—

	£
European staff	4,037
Subordinate staff	1,410
Porters, &c.	2,195
Other charges	612
Total	£8,254

The estimated total expenditure for the maps on the scale of $\frac{1}{125000}$ is £35,667, to be spread over eight years dating from 1st January, 1905; an annual cost of £4,833. From the same date the estimated total expenditure of cadastrally surveying the 15,000 square miles of the kingdom of Uganda, to be spread over about nine years, is £36,119, an annual cost of £4,013. The total gross annual cost in the future will, therefore, be about £8,846. But the net annual cost of the survey will be considerably less than this sum, since, for the $\frac{1}{10000}$ cadastral plans, survey fees are to be charged at the rate of £1 6*s*. 8*d*. per square mile to the owners of the larger estates, at 1*d*. per acre for the smaller estates, whilst the Kabaka's estates and the official estates will be subject to a registration fee of £1 each. As the areas in question are at present unknown the exact sum recoverable cannot be stated, but it will probably exceed £10,000.

General Remarks.

The triangulation of Uganda is proceeding well and the topographical map has made a good start; but the cadastral work is undoubtedly progressing at too slow a rate. It is necessary to increase greatly the rate of execution of the cadastral survey. The Chief Surveyor is now in England, and is elaborating a scheme whereby the whole of the required area may be surveyed in the next eight years. Some of the methods adopted may be painful to the feelings of the academic surveyor, but the desired result will be attained by employing these methods. It is ridiculous to waste money on unnecessary precision, and it is sheer waste of time to lay down accurate lines which are obliterated when the bush and grass grow up.

Difficulties of Survey Work in Africa.

It is important to avoid looking upon a survey department in Tropical Africa as working under reasonably favourable conditions. In the protectorate in question it is necessary to note several causes which increase the difficulties of the surveyor's task; and first of these comes the haze which settles down upon the land at certain periods and lasts sometimes for weeks, sometimes for months. The origin of the haze is not known, no doubt a small share is to be credited to the grass and bush fires which occur twice in each year. Certain survey operations are rendered absolutely impossible during the haze, and all operations are hindered. Next amongst the difficulties is to be mentioned the want of a subordinate staff. The native of Uganda has not as yet the adaptability of the West Coast negro; the native of India (altogether admirable as he usually is as a surveyor in his own country) has not proved a success in Uganda, partly because the climate does not suit him. The absence of a subordinate staff makes the work slow and expensive. Then the sleeping sickness obliges a restriction or even a suspension of work in the neighbourhood of the lake. And lastly, in the clear seasons the high grass immensely increases the labour of laying out property boundaries—a work upon which the tranquillity of the country largely depends.

IV.

HYDROGRAPHIC SURVEYS.

Lake Nyasa.

Lieutenants E. L. Rhoades and W. B. Phillips, R.N.R., completed a survey of Lake Nyasa, and the results of their work is contained in a map published by the Royal Geographical Society in 1902. Scale $\frac{1}{1000000}$. The map gives soundings and sections.

The Victoria Nyanza.

Commander B. Whitehouse, R.N.R., has been engaged on the hydrographic survey of the Victoria Nyanza. Admiralty chart No. 3,252 shows the northern part of the lake and is from his work.

Writing in March, 1906, Commander Whitehouse says :—

"Since my return I have done a 6-inch plan of Entebbe, Bukoba, and Lubembe, have completed triangulation over the whole lake, finished coast line from Nassa to Kagera River (about 750 miles), this completes the shore of the lake, and have mapped the islands east of Bukoba and west of Ukerewe.

* * * * * *

"There only now remains to map the islands from here (Unvanga) to Bumbire . . . . It seems to me that a surveyor will be required here for some years."

Commander Whitehouse has not yet had time to complete his work for publication.

COLONIAL REPORTS.

The following recent reports relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony.	Year.
472	British Central Africa Protectorate	1904–1905
473	Mauritius	1904
474	Fiji	"
475	East Africa Protectorate	1904–1905
476	Northern Nigeria...	1904
477	British Guiana	1904–1905
478	Leeward Islands	"
479	Bechuanaland Protectorate	"
480	Basutoland...	"
481	Ceylon	1904
482	St. Lucia	"
483	Ashanti	1905
484	Bermuda	"
485	Hong Kong	"
486	St. Helena	"
487	Weihaiwei	"
488	Gold Coast...	"
489	Seychelles	"
490	Falkland Islands	"
491	Gambia	"
492	Jamaica	1904–1905
493	Northern Territories or the Gold Coast ...	1905
494	Ceylon	"
495	Turks and Caicos Islands	"
496	Bahamas	1905–1906
497	Barbados	"
498	Malta	"
499	British Central Africa Protectorate	"

MISCELLANEOUS.

No.	Colony.	Subject.
28	Gold Coast and Sierra Leone	Rubber.
29	Ceylon	Geological Survey.
30	Pitcairn Islands	Report by Mr. R. T. Simon.
31	Northern Nigeria	Cotton, &c.
32	Do. do.	Mineral Survey.
33	Southern Nigeria	Do.
34	Montserrat	Agricultural Industry.
35	Antigua and St. Kitts-Nevis	Sugar.
36	West Indies	Work of Imperial Department of Agriculture.

Trade (Imports and Exports) of the United Kingdom with the Colonies and Foreign Countries, Rates of Wages and Hours of Labour at Home and Abroad; Customs Tariff; Food Supply, &c., viz.:—

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[Cd. 3022.] Do. do. do. Vol. II. Price 4s. 2d.
[Cd. 2797.] Foreign Import Duties, 1905. Price 2s.
[Cd. 3093.] Navigation and Shipping Statement. 1905. Price 3s. 1d.
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THE SURVEYS AND EXPLORATIONS

OF

BRITISH AFRICA.

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

FIRST YEAR.

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October, 1906.

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1906.

[Cd. 2684–16.] *Price* 2*s.* 7*d.*

1 8

COLONIAL REPORTS—ANNUAL.

No. 532.

THE SURVEYS OF BRITISH AFRICA.

533 105 19

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

SECOND YEAR.

To July, 1907.

24 Br. Col. 81

(For Report for 1905–6, *see* No. 500.)

Presented to both Houses of Parliament by Command of His Majesty.
August, 1907.

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D. of D.

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CAPE COLONY.—RECONNAISSANCE SURVEY TRANSPORT.

No. 532.

COLONIAL SURVEY COMMITTEE REPORT, JULY, 1907.

The following Report, which was considered at a meeting of the Colonial Survey Committee held on the 24th July, 1907, has been submitted to and approved by the Secretary of State for the Colonies.

R. C. HELLARD, *Colonel.*
H. J. READ.
C. F. CLOSE, *Major, Gen. Staff.*

W. C. BOTTOMLEY, *Secretary.*

I.

REVIEW OF THE WORK OF THE PAST YEAR.

Topographical Surveys.—A total area of about 49,000 square miles has been topographically surveyed in the field, as under :—

Orange River Colony	8,000 sq. miles.
Cape Colony	17,000 „ „
East Africa	2,400 „ „
Uganda	250 „ „
Gold Coast (includes work previously in hand)	16,000 „ „
S. Nigeria (partial)	5,000 „ „

Longitude Expedition.—The results of the Nigeria Longitude Expedition have been computed; their accuracy is very satisfactory.

Geodetic Triangulation.—The British South Africa Company has completed the measurement of the meridian 30° E.

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of Greenwich as far north as a point within 70 miles of Lake Tanganyika.

Geographical Explorations have been proceeding in the Anglo-Egyptian Sudan.

Cadastral Surveys have been in progress in the Anglo-Egyptian Sudan, Gold Coast, Uganda, and East Africa. In the last Protectorate an area of 870,267 acres was surveyed during the year. In the Sudan 578,000 acres have been surveyed during the year.

Boundary Commissions.—Two Commissions have been, and are still, at work along the W. frontier of Uganda, and the N. frontier of Northern Nigeria, respectively.

Maps Published.—General maps have been published of British Central Africa, the Gold Coast and Northern Territories, and the Gambia.

Boundary maps have been published of the Anglo-Portuguese (Zambesi) frontier, and the Anglo-German (Niger-Cameroon) frontier south of the Cross River; provisional sheets have been printed of the Anglo-German frontier east of Lake Victoria.

The following topographical sheets have been published :—

Orange River Colony (military edition) ...	5
The Cape Colony	6
East Africa	1
Gold Coast	2
Africa $\frac{1}{1000000}$ series	10
„ $\frac{1}{250000}$ compilations	21

Inspection.—An independent inspection of the Survey Departments of East Africa and Uganda was made during the year.

II.

GENERAL REMARKS.

(i.) *Necessity for Surveys.*
(ii.) *The Colonial Survey Committee.*
(iii.) *Uniformity.*
(iv.) *Topographical Maps and Cadastral Plans.*
(v.) *Class of Instruction.*
(vi.) *Employment of Natives.*
(vii.) *Geographical Attachment of Africa to Europe.*
(viii.) *Boundary Commissions.*

(i.) Necessity for Surveys.

The purposes for which maps are required in the administration of a country (especially an undeveloped country such as a protectorate in Tropical Africa) are many and varied.

Maps are necessary to define the exact limits of national territory, to show the areas and villages under the rule of native chiefs; they are essential for land registration and settlement, for the allotment of mining and forest concessions, and for the organization of internal communications.

Of their necessity in war the experiences of the army in South Africa afford an eloquent testimony, and even the conduct of a "small war" or a police expedition is much simplified by the existence of reliable maps of the scene of operations.

(ii.) The Colonial Survey Committee.

The Colonial Survey Committee is an Advisory Committee formed at the instance of the Secretary of State for the Colonies to advise him in matters affecting the survey and exploration of British Colonies and Protectorates, more especially those in Tropical Africa.

The Committee was constituted in August, 1905, and consists of:—

A representative of the Colonial Office.
The Director General of the Ordnance Survey.
The officer in charge of the Topographical Section of the General Staff.

It is the duty of the Colonial Survey Committee to make such recommendations as will ensure the rapid and economical prosecution of accurate surveys where these are required, and the rendering the results available, as speedily as possible, for use by the Home Government, the Colonial Governments, and the public.

(iii.) Uniformity.

The great variety of the natural conditions of the surface features of the Tropical Colonies and Protectorates renders it impossible to lay down any uniform system of work in the field. Each case must be dealt with on its merits. The technical methods suitable for different types of country (such, for instance, as undulating grass regions, forest clad mountainous tracts, deserts or mangrove swamps) are well known.

Uniformity is, however, required in the following particulars :—

(*a.*) The figure of the earth adopted is that of Clarke.

(*b.*) The Topographical Maps are to be bounded by meridians and parallels, and the border lines are to fit in with the intervals adopted by the Topographical Section of the General Staff for the map of Africa on the scale of $\frac{1}{1000000}$.

(*c.*) The scales to be used are the following :

Topographical Maps.	Cadastral Plans.
$\frac{1}{63360}$	$\frac{1}{2500}$
$\frac{1}{125000}$	$\frac{1}{5000}$
$\frac{1}{250000}$	$\frac{1}{10000}$
$\frac{1}{500000}$	
$\frac{1}{1000000}$	

In exceptional cases where large scale town plans are required the following scales may be adopted $\frac{1}{500}$, $\frac{1}{1000}$.

(iv.) Topographical Maps and Cadastral Plans.

A Topographical Map is an accurate graphic representation of a portion of the earth's surface showing all the accidents of the surface, both natural and artificial, which can be depicted on the scale selected. Such maps are usually on small scales, but any complete representation of a portion of the earth's surface which shows natural features (including the "relief"), and such artificial features as the scale will permit, is a Topographical Map.

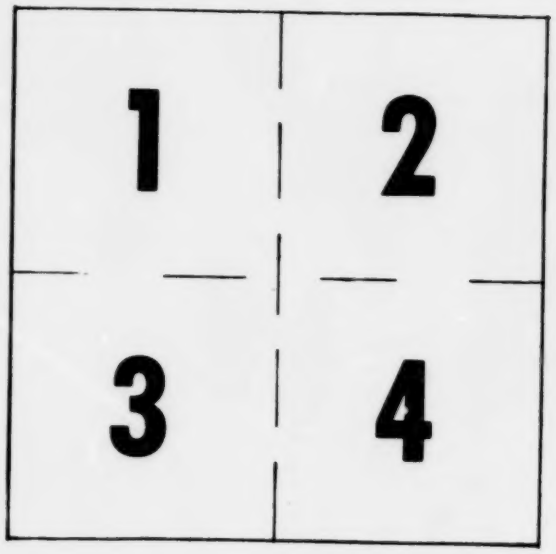
Examples of Topographical Maps are :—

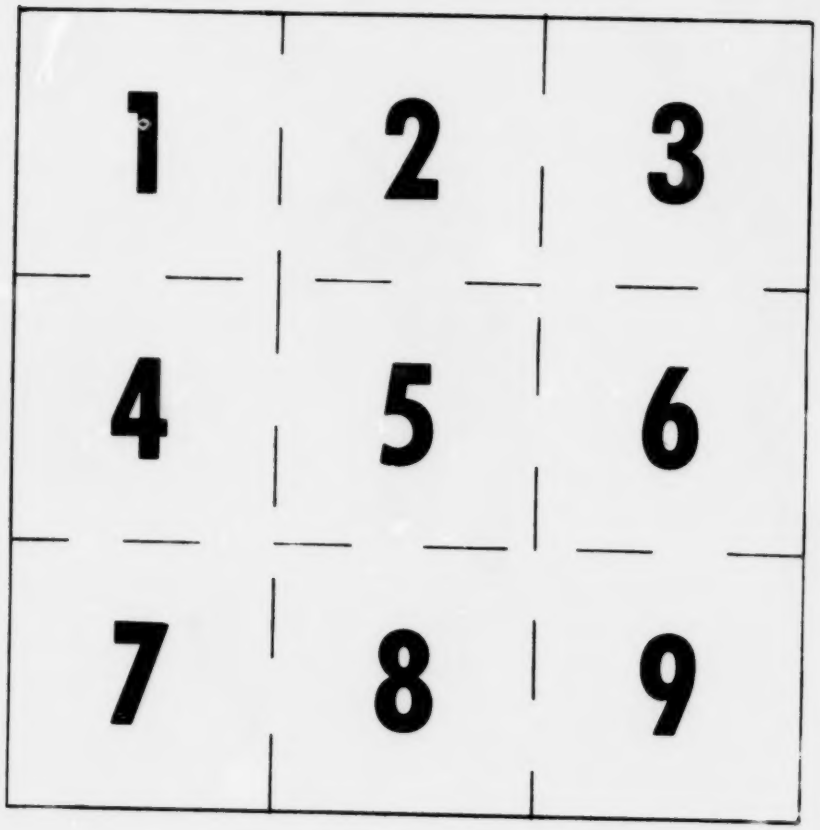
The $\frac{1}{63360}$ (1 inch to a mile) Ordnance Map of England.

The $\frac{1}{80000}$ Map of France.

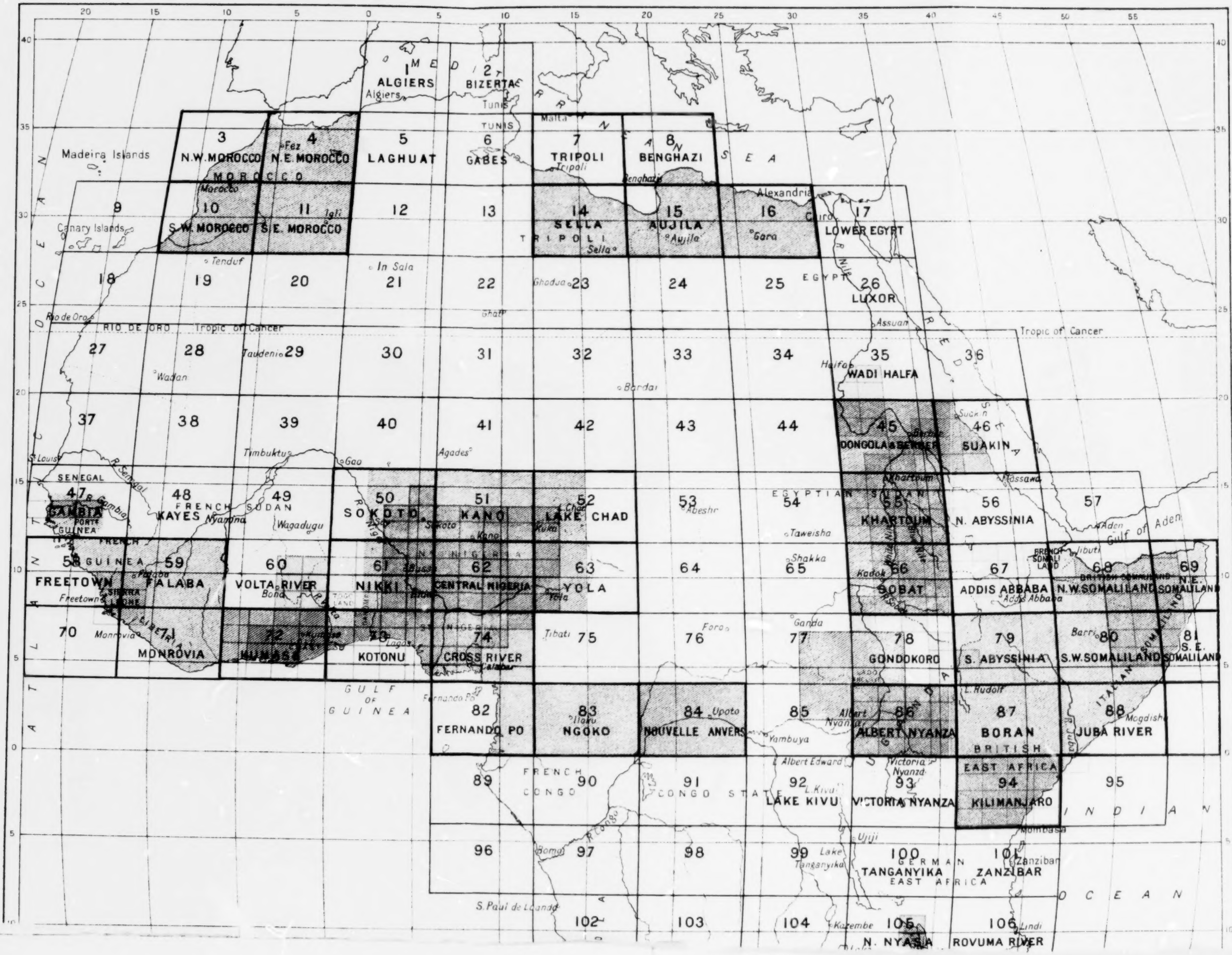
The $\frac{1}{100000}$ Map of Germany.

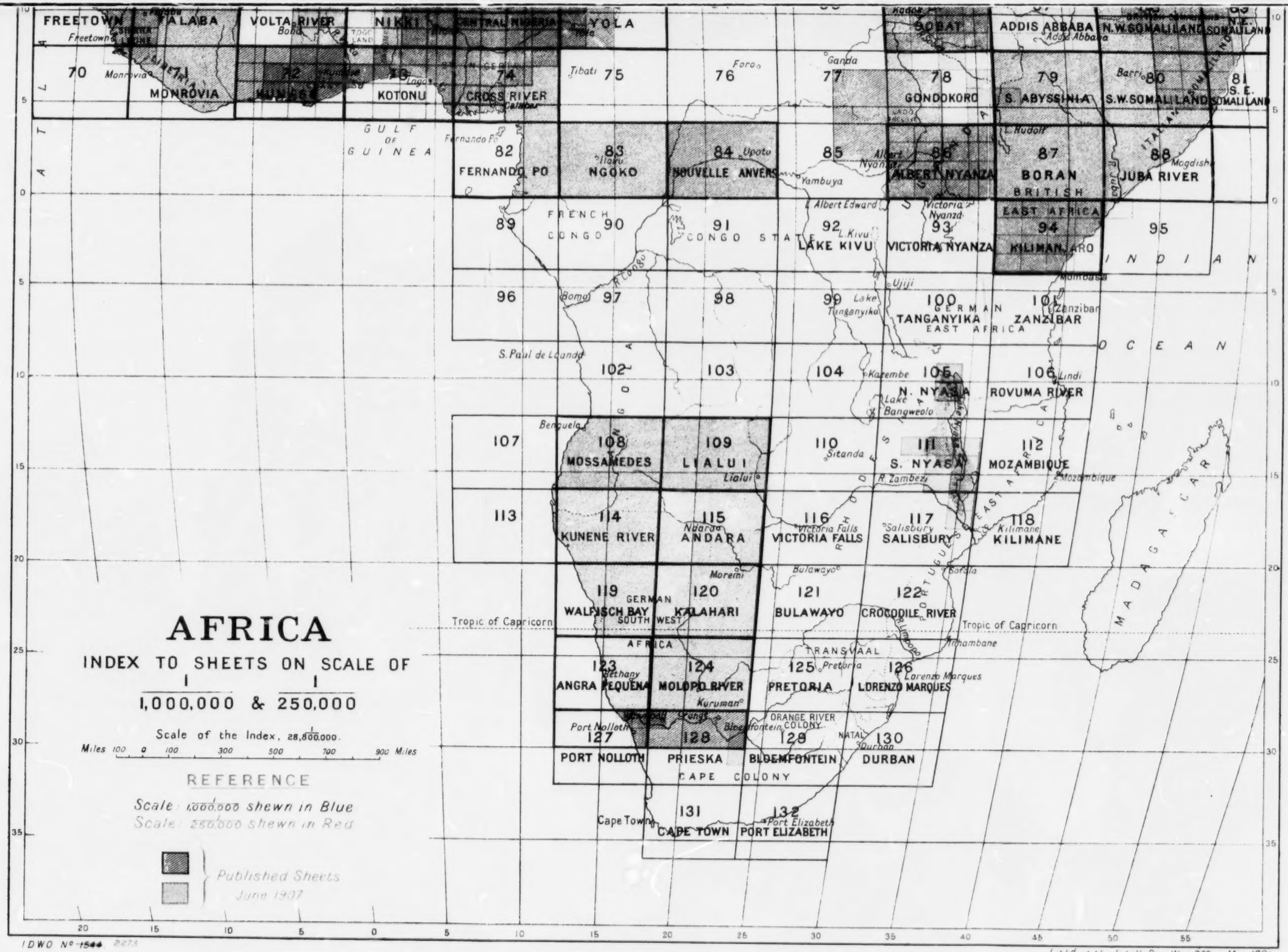
Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





INDEX TO 1:1,000,000 & 1:250,000 T.S.,G.S. SHEETS OF AFRICA WHICH ARE ON SALE.





AFRICA

INDEX TO SHEETS ON SCALE OF 1/1,000,000 & 1/250,000

Scale of the Index, 28,800,000.

Miles 100 0 100 300 500 700 900 Miles

REFERENCE

Scale 1,000,000 shewn in Blue

Scale 250,000 shewn in Red

Published Sheets June 1907

IDWO Nº 1544 2273

Lithd at the Intell. Div. War Office. May 1901

Revised July 1907

AGENTS FOR THE SALE OF MAPS PUBLISHED BY THE TOPOGRAPHICAL SECTION, GENERAL STAFF

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A Cadastral Plan, on the other hand, is essentially concerned with the artificial features of the surface, although natural features which affect the object of the plan are also included. Such plans are most frequently required to show property boundaries, and are usually constructed on scales varying from $\frac{1}{10000}$ to $\frac{1}{500}$.

As examples of Cadastral Plans may be quoted the $\frac{1}{2500}$ plans of the United Kingdom, or the farm plans of the South African Colonies.

(v.) Class of Instruction.

Arrangements have been made for a class of civil and military officers in Colonial employment to assemble at Southampton each year towards the end of May or beginning of June, for a month's instruction in surveying, and it is hoped that officers and officials who may be coming home on leave from the Colonies during the summer, will apply for permission to attend this class, with a view to improving their knowledge of how to collect and record topographical information in the districts they may have to move over, and of the methods best adapted for various classes of country according to the time available. The application should accompany the application for leave.

It is important, especially in Protectorates which have no regular survey department, that officers and officials should be able to make traverse and reconnaissance sketches of the routes in their districts of such a degree of accuracy as to permit of their being adjusted to the points fixed astronomically. It is with this in view that these classes have been instituted, and the course of instruction is confined chiefly to methods applicable to tropical countries, and opportunities are afforded of getting a general insight into combined surveys both with the plane table and the prismatic compass.

(vi.) Employment of Natives.

On general grounds it is desirable to employ natives in the Government service of tropical Dependencies to as great an extent as their education and abilities fit them for such service. In the case of the survey departments of the African Protectorates there is the special reason that the exclusive employment of white surveyors is extremely expensive.

It was thought that it might be advisable to establish a central training school in which natives might be trained for employment in all the British African surveys; but careful investigation has shown that the scheme is not practicable. It is intended in the future to arrange that each department shall train natives for its own use. Considerable success has been attained in this way in the Gold Coast and in Southern Nigeria, and the possibility of training Uganda natives, who are as a rule very intelligent, has not been overlooked.

(vii.) The Geographical Attachment of Africa to Europe.

The continent of Africa is attached geographically to Europe in the following way. The geodetic triangulation of Algeria is connected with that of Spain by rays which cross the Mediterranean. The same triangulations are also connected astronomically by exchange of telegraphic signals for longitude. The difference of longitude between Suez and Greenwich has been determined telegraphically, and the difference of longitude between Cape Town and Greenwich has been determined in the same way. Based on the value for Suez are all the surveys of Egypt and the Anglo-Egyptian Sudan. Based on the value for Cape Town is the whole of the geodetic triangulation of South Africa. Based also on Cape Town by exchange of telegraphic signals are the positions of Accra, Bonny, and Lagos on the West Coast, and on the positions of these towns depend the surveys of the Gold Coast and of Southern and Northern Nigeria, in which a large number of telegraphic longitudes have recently been determined. British Central Africa and the Lake Nyasa region depend on the longitude of Nkata, near the western shore of that lake, which was fixed by telegraph from Cape Town. From Cape Town also has been determined the position of Zanzibar, and on the latter depends the longitude of Mombasa. From Zanzibar a good (but not geodetic) chain of triangles extends to Kilimanjaro and Victoria Nyanza and on to Albert Edward Nyanza and Ruwenzori. The longitude of Port Florence on Victoria Nyanza has also been fixed telegraphically from Mombasa.

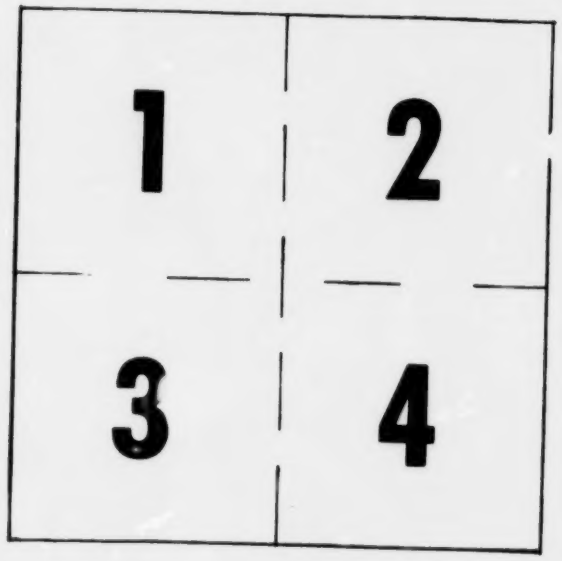
(viii.) Boundary Commissions.

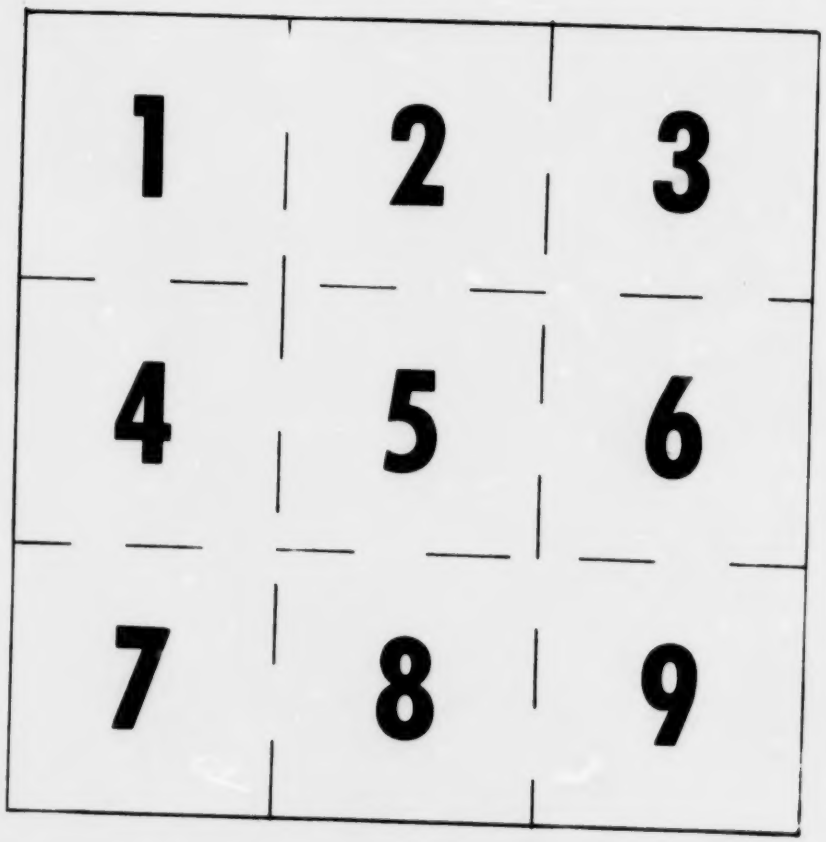
The delimitation of international frontiers has been an indirect means of surveying some of the outlying portions of the tropical Protectorates. In fact, in most of our tropical African possessions the perimeter is more accurately mapped than the interior. There are now no "hinterlands" in British Africa, the partition of the continent is complete, and the boundaries are, with few exceptions, well defined.

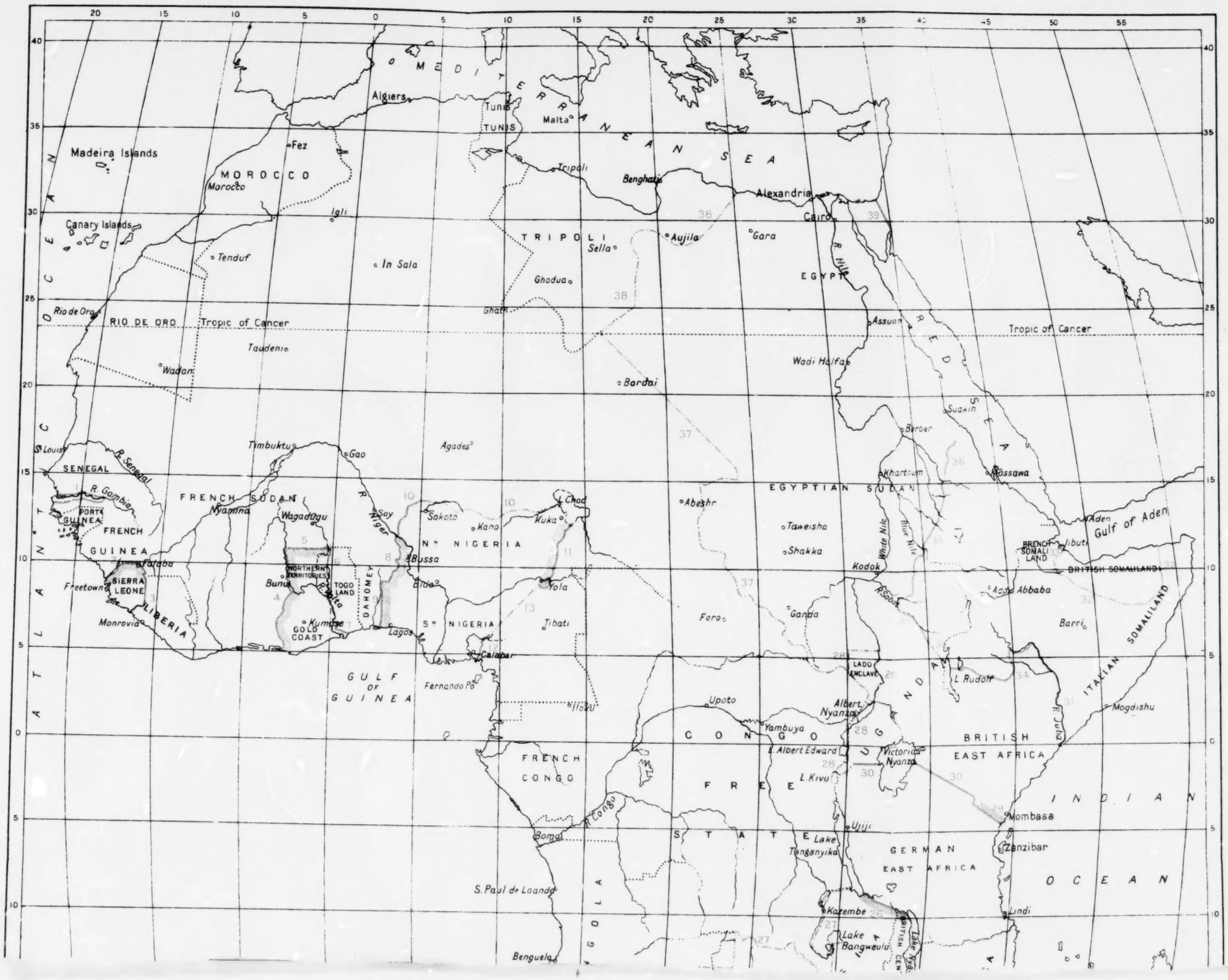
The total length of international frontiers traversed by British Boundary Commissions in Africa up to July, 1907, is 9,250 miles.

The following are the stages in the business of delimiting an international frontier. First there is an international agreement drawn up on broad lines; each Government then appoints Commissioners, who meet at one end of the boundary and march along it exploring and mapping the boundary zone. The Commissioners, having arrived at the other end, agree upon the geographical position of the principal features and decide upon the details of the frontier, paying special attention to the incidence

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.






Algiers
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Malta
MEDITERRANEAN SEA
Madeira Islands
MOROCCO
Morocco
Fez
Igli
Tripoli
Benghazi
Alexandria
Cairo
Canary Islands
TRIPOLI
Sella
Aujila
Gara
In Sala
Tenduf
Ghadua
Ghat
EGYPT
Rio de Oro
RIO DE ORO
Tropic of Cancer
Taudenio
Wadan
Assuan
Wadi Halfa
Bardai
RED SEA
Tropic of Cancer
Berber
Suakin
Timbuktu
Gao
Agades
St Louis
SENEGAL
R. Senegal
R. Gambia
FRENCH SUDAN
Nyamina
Wagadugu
R. Niger
Say
Sokoto
Kano
Kuka
Chad
Abeshr
Khartoum
Kassawa
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Taweisha
Shakka
White Nile
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Fataba
Bussa
Kodok
BRITISH SOMALILAND
Jibuti
FRENCH SOMALI LAND
SIERRA LEONE
Freetown
NORTHERN TERRITORIES
Bunua
TOGO LAND
DAHOMEY
Bida
Yola
Addis Abbaba
LIBERIA
Monrovia
Kumasi
GOLD COAST
Lagos
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ITALIAN
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Mogdishu
Yambuya
CONGO FREE STATE
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BRITISH EAST AFRICA
L. Albert Edward
Victoria Nyanza
L. Kivu
FRENCH CONGO
R. Congo
Ujiji
Mombasa
Bomal
Lake Tanganyika
GERMAN EAST AFRICA
Zanzibar
INDIAN OCEAN
S. Paul de Loanda
Kazembe
Lindi
Lake Bangweulu
Benguela
ANGOLA
ATLANTIC OCEAN

DIAGRAM TO ILLUSTRATE THE PROGRESS OF THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA

Scale of the Diagram
28,312,000 or 1 Inch to 450 Miles

Miles 100 0 100 300 500 700 900 Miles

British Boundaries marked & ratified
Do Do surveyed
Do Do not yet surveyed

ATLANTIC OCEAN
R. Gambia
PORTS GUINEA
FRENCH GUINEA
Freetown
SIERRA LEONE
Monrovia
LIBERIA
FRENCH SUDAN
Nyamina
Wagadugu
R. Niger
Say
Sokoto
Kano
Chad
Kuka
N. NIGERIA
Abussa
Bida
Yola
Tibati
S. NIGERIA
Lagos
Calabar
Fernando Po
GULF OF GUINEA
NORTHERN TERRITORIES
Bunda
TOGO LAND
DAHOMEY
GOLD COAST
Kumase
Ilorin
FRENCH CONGO
Upoto
Yambuya
CONGO FREE STATE
L. Albert Edward
L. Kivu
Albert Nyanza
LADO ENCLAVE
UGANDA
L. Rudolf
EGYPTIAN SUDAN
Abeshr
Taweisha
Shakka
Kodok
White Nile
Blue Nile
Fora
Ganda
R. Sobat
Addis Abbaba
Barri
Aden
Gulf of Aden
BRENCH SOMALI LAND
Libuti
BRITISH SOMALILAND
ITALIAN SOMALILAND
Mogdishu
R. Juba
BRITISH EAST AFRICA
Victoria Nyanza
Mombasa
Zanzibar
INDIAN OCEAN
Ujiji
Lake Tanganyika
GERMAN EAST AFRICA
Lindi
Bomal
R. Congo
S. Paul de Loanda
ANGOLA
Benguela
Kazembe
Lake Bangweulo
BRITISH CENTRAL AFRICA
Lake Nyasa
Sitanda
Lialui
R. Zambezi
Mozambique
PORTUGUESE EAST AFRICA
Ndara
Victoria Falls
Salisbury
Kilimane
MADAGASCAR
Moremi
Bulawayo
Sofala
GERMAN SOUTH WEST AFRICA
Walfish Bay
Tropic of Capricorn
R. Limpopo
PORTUGUESE
Inhambane
TRANSVAAL
Pretoria
Lorenco Marques
Bethany
Kuruman
Hammbag
Orange
Port Nolloth
Bloemfontein
ORANGE RIVER COLONY
NATAL
Durban
CAPE COLONY
Cape Town
Port Elizabeth

T.S.G.S. No 2226 (a)

War Office August 1906.
Revised July 1907

of tribal boundaries and to the future nationality of the villages. They then march back along the line, erect pillars and inform the chiefs. A protocol in duplicate is drawn up and signed, and each Chief Commissioner forwards the protocol and maps with a report to his Government. The protocol is then approved by the two Governments, and in some instances a fresh agreement on the terms of the protocol (with perhaps minor modifications) is drawn up and signed by representatives of the Governments.

Not every commission has followed this course exactly, but the above sketch of procedure will serve to indicate the various stages through which frontier negotiations usually pass.

The following Boundary Commissions have been at work during 1906–07:—

The Anglo-French, Niger-Chad Commission, to demarcate the frontier to the north of Northern Nigeria in accordance with the detailed protocol signed in London on the 9th April, 1906. British Commissioner, Major R. A. P. O'Shee, R.E. This Commission is still at work.

The Anglo-Congolese, Uganda-Congo Commission, to map the country in the neighbourhood of the meridian 30° E. of Greenwich, from the parallel 1° S. to the Nile-Congo watershed. This Commission has instructions to prepare a joint map, and to come to an agreement as to the geographical features. It has no authority to mark out the boundary. British Commissioner, Lieut.-Colonel R. G. T. Bright, C.M.G., Rifle Brigade. This Commission is still at work.

The Anglo-German, Southern Nigeria-Cameroon Commission, to demarcate the frontier from near the rapids of the Cross River to the sea, completed its work in the field in May, 1906. The British Commissioner was Captain A. S. Woodroffe, R.E. The protocol was signed by the Commissioners in December, 1906.

Section III. of this Report consists of a list of Boundary Commissions, showing the frontiers which have been delimited and the progress made in each case.

III.

TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed	Finally approved.	
1	Gambia (Anglo-French)	425	Aug. 10th, 1889	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Leconte, Civil Administrator.	Nov., 1890, to May, 1891	May, 1891	May, 1891.	—	—
1	" "	—	" "	British :— Mr. Reeve. Mr. Ozanne. French :— M. Fargue. Lieut. de Jussien. M. Robert (Interpreter).	1895-6	—	—	—	—
1	" "	—	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898-9.	—	—	—	—
1	" "	—	April 4th, 1904	British :— Major Cowie, W.I.R.	1905-6.	—	—	—	—
2	Sierra Leone—French Guinea.	260	Convention, Jan. 21st, 1895	British :— Capt. A. H. Kenney, R.E French :— M. Lamadon, Governor of the French Colony of Les Rivières-du-Sud.	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembi-Kunde
2	" "	—	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Miliot.	Dec., 1895, to May, 1896.	1895, 1896	April 30th, 1896	—	From the Coast to Tembi-Kunda.

2	" "	—	Jan. 15th, 1903 .. .	British :— Mr. Birch. French :— M. Lescure.	1900 and Jan. 15th, 1902.	1903.	Mar. 3rd, 1903.	March and April, 1904.	Tembi - Kunda Eastwards.
3	Sierra Leone—Liberia ..	195	" "	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	—	—
4	Gold Coast—Ivory Coast (Anglo-French).	450	July 12th. 1893. and March 21st, 1899.	British :— Major A. E. G. Watherston, R.E. Capt. Soden. R. Fus. Capt. H. B. Des Voeux, R.E. French :— M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903	Feb 1st, 1903.	May, 1905	—
5	Gold Coast, Northern Territories — French Sudan (Anglo-French Boundary North of Gold Coast).	195	Convention, June 14th, 1898, and March 21st, 1899.	British :— Major A. E. G. Watherston, R.E Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	1904	Aug. 16th, 1901	May, 1906.	—
6	Gold Coast, Northern Territories — Togo (Anglo-German).	165	Convention, July 1st, 1890. and Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E. Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried.	Dec., 1901, to Sept., 1902	—	June 9th, 1903	—	—
6	" "	"	" -	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.	—	Sept., 1904, to Dec. 15th, 1905.	—	June 25th, 1904.	North of 9th parallel only.
7	Gold Coast — Togoland (Anglo-German).	125	" -	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	—	—	—	—

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
8	Lagos—Dahomey (Anglo-French).	235	March 21st, 1899 ..	British :— Major J. I. Lang, R.E., C.M.G. French :— Commdt. Touteé.	1900	—	Dec. 22nd, 1900, and Jan., 1905	Oct. 1906.	From 9° N. Lat. to Niger. In one exchange of notes.
8	„ „ ..	200		——	1895-6.	—	Oct 12th,? 1898, Art. II. June 14th, 1898.	Oct. 1906.	From the Coast to 9° N.Lat. Treaty Series No. 15, 1899.
8	„ „ ..			British :— Capt. Anderson. French :— M. Perreur.	1900.	—	—	—	—
10	Niger—Chad (Anglo-French).	860	March 21st, 1899 ..	British :— Lieut.-Col. G. S. McD. Elliott, R E. Capt. C. H. Foulkes, R.E. Capt. G. R. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty. Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906, May 29th, 1906.	—	—
10	„ „	„	May 29th, 1906	British :— Major R. P. O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Andoin. Lieut. Vignon.	1906.	—	—	—	

11	Yola—Chad (Anglo-German).	350	Convention, Nov. 15th, 1893 Preliminary Agreement, Dec. 14th, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E. Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B. Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Feb., 1903, to Feb., 1904 and 1905.	—	Feb. 24th, 1904, and Mar. 19th, 1906.	Aug. 24th, 1906.	—
11	" "	"	" "	Local Commission to mark Boundary. British :— (?) German :— Leut. von Stephani.	—	1906 to 1907.	Feb. 12th, 1907.	—	—
12	Cross River (Southern Nigeria—Kameruns).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug., 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th, 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1895.	—	—	—	—
12	" "	"	" "	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	—
13	Cross River Rapids—Yola Arc.	285	—	—	1907	—	—	—	Expedition will leave England this Autumn.
14	Barotseland—Angola ..	710	Convention, July 29th, 1901, and Arbitration award, May 30th, 1905.	—	—	—	—	—	Not yet delimited.
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	—	—	—	—	—	Not yet delimited.
16	Bechuanaland—German South-West Africa.	1113	July 1st, 1890, Art. III. (A.G.); Dec 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British :— Major H D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1898 to 1903	—	—	Part only of boundary delimited

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	Remarks.
17	Amatongaland — Portuguese East Africa.	30	June 11th, 1891, Art. III.	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes de Selva.	Aug., 1896, to Dec., 1896.	—	—	—	—
17	" "	"	" " "	British :— Mr. W. Bosman. Portuguese :— Lieut. M. Newparth.	—	Oct., 1897.	—	—	—
18	Swaziland — Portuguese East Africa.	65		—	1888, 1894, and 1897.	—	—	—	Portuguese and Boer Commission.
19	Transvaal — Portuguese East Africa.	255	July 29th, 1869. Convention of London, Feb. 27th, 1884.	—	1887, 1890, and 1894.	1887, 1890, 1894.	—	—	Portuguese and Boer Commission.
20	Limpopo River to Sabi River (Anglo - Portuguese).	115		—	Dec. 1902, to 1905.	—	—	June 3rd 1907.	— In one exchange of notes.
21	Mazoe or Manica Boundary (Anglo - Portuguese 18° 30′ S. to Sabi River).	235	June 11th, 1891	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	June 3rd 1907.	Arbitral award, 1897. In one exchange of notes.
21	"	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade.	—	1898 1899	June 5th and 28th, 1898, and Dec. 14th and 15th, 1898	—	—
22	Barue Boundary (Anglo-Portuguese, River Mazoe, and 18° 30′ South)	145	June 11th, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E.	1898.	1905 to	Dec. 28th, 1898.	—	—

23	Anglo-Portuguese Boundary South of River Zambesi.	215	June 11th, 1891	British :— Mr. Sawerthal. Portuguese :— Lieut. Durao.	1903-4	—	—	—	Provisional survey.
23	" "	215	" "	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. S. Gugo Coutinho.	April 1905, to Oct., 1905.	1905.	Oct. 20th, 1905.	—	—
24	Anglo-Portuguese Boundary North of Zambesi	260	" "	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. S. Gugo Coutinho.	June, 1904, to Nov., 1904.	1904.	Nov. 22nd, 1904.	—	—
25(*a*)	British Central Africa—Portuguese East Africa (Anglo-Portuguese).	660	" "	British :— Mr. J. F. Cunningham. Mr. T. J. Binnie, Surveyor Portuguese :— Capt. Ferraz. Conde. Du Pont. Capt. Branco.	1899-1901.	1899-1901.	—	—	Section from River Ruo to Lake Chiuta Provisional Boundary Commission.
25(*b*)	" "			British :— Mr. A. James Swann. Mr. Thomas J. Binnie, Surveyor.					
25(*c*)	" "		" "	Local Commission :— British :— (?) Portuguese :— 2nd Lieut. Antonio de Brito.	—	1907.	—	—	To make some alterations to previous line and settle ownership of some islands.
26	Nyasa-Tanganyika (Anglo-German).	225	July 1st, 1890	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Boileau, R.E. Capt. Chichester. Lieut Scratchley. German :— Hptmann Herrmann. Lieut. Glauning. Dr. Kohlschütter.	1898.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved	
27	Congo Free State—North-West Rhodesia.	1200	May 12th, 1894	—	—	—	—	—	Not yet delimited.
28	Congo Free State—Uganda and Sudan.	800	May 12th, 1894, and May 9th, 1906.	—	—	—	—	—	—
29	British — German East Africa (Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith, R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 25th, 1893.	—	—
29	" " "	"	July 25th, 1893	British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897	1900.	Jan. 28th, 1900, and April 25th, 1900.	—	Not beaconed throughout its entire length.
30	British — German East Africa (South end of Jipe to Lake Victoria).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	—
30	German East Africa—Uganda.	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W Schwartz. Oblt. M. Weiss.	July, 1902, to Apr. 1904.	1904	July 18th, 1906.	—	—
31	Italian Somaliland — British East Africa.	375	Italian agreement of May 5th, 1894.	—	—	—	—	—	Not yet delimited.

32	British Somaliland — Italian Somaliland.	710	Italian agreement, May 5th, 1894.	—	—	—	—	—	—	—	Not yet delimited.
33	British Somaliland — French Somali Coast.	50	February 2nd, 1888 ..	—	—	—	—	—	—	—	Not yet delimited.
34	Uganda — Abyssinia Boundary.	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900–01.	—	—	—	—	—	—
34	" " "	"	—	Capt. P. Maud, R.E. Mr. J. B...rd.	Oct., 1902, to July, 1903.	—	—	—	—	—	—
35	Sudan—Abyssinia ..	760	Treaty, May 15th, 1902	Major H. H. Austin, R.E. Lieut. C. W. Gwynn, R.E.							R. Statit to Abu Gamal
35	" " ..	"	" " "	Brev.-Major C. W. Gwynn, R.E.	1903.	1903.	—	—	—	—	—
36	Sudan—Eritrea	330	Treaty, July 10th, 1900, November 22nd, 1901, May 15th, 1902.	British :— Col. the Hon. M. G. Talbot, R.E. Italian :— Major Martinelli. Tenente. A. Pollera. Capt. Tornare.	1903.	—	—	—	—	—	From Sabderat North - Eastwards.
36	" " ..	"	" " "	Brev.-Major W. J. Walter, Lancs. Fus.	1899, 1901.	—	—	—	—	—	Not yet delimited.
37	Anglo - French — From Congo-Nile Watershed to Tripoli.	1,950	March 21st, 1899 Treaty, Series 15, 1899.	—	—	—	—	—	—	—	Not yet delimited.
38	Egypt—Tripoli	1,000	—	—	—	—	—	—	—	—	—
39	Egypt—Turkish, Sinai Peninsula.	140	Firman, 1841	British :— Capt. R. C. Owen. Mr. Wade. Mr. Keeling. Turkish :— Mazzaffer Bey. Fehim Bey.	1906.	—	—	—	—	—	—

IV.

REPORTS ON THE SURVEYS

OF

ANGLO-EGYPTIAN SUDAN.
BRITISH CENTRAL AFRICA.
EAST AFRICA.
GAMBIA.
GOLD COAST.
NORTHERN NIGERIA.
RHODESIA.
SIERRA LEONE.
SOUTH AFRICA (GENERAL).
THE CAPE COLONY.
THE ORANGE RIVER COLONY.
SOUTHERN NIGERIA.
UGANDA.

THE ANGLO-EGYPTIAN SUDAN.

Sirdar	Major-General Sir F. R. WINGATE, K.C.B., K.C.M.G., D.S.O.
Director of Surveys...	Captain H. D. PEARSON, R.E.
Assistant-Director of Surveys	Lieutenant A. E. CONINGHAM, R.E.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but it has been thought desirable to include an account of these surveys in order to make the review of the mapping of British Africa more complete.

The following report has been kindly furnished by the Director of Surveys.

(i.) *Existing State of Survey and Scheme of Work.*
(ii.) *Work during* 1906–07.
(iii.) *Native Surveyors.*
(iv.) *Topography.*
(v.) *Levelling.*
(vi.) *Staff.*

(i.) Existing State of Survey and Scheme of Work.

The very large area of the Anglo-Egyptian Sudan (about one million square miles), and the limited funds available have prevented a systematic survey of the country being taken up. The settlement of the Abyssinian and Eritrean frontiers made triangulation necessary in these parts; two years ago accurate longitudes were required in the neighbourhood of the Egyptian boundary in order to determine the limits of gold mining concessions; the trouble last year in the Jebels in Southern Kordofan rendered an accurate survey of these parts advisable; and the growing demand for cadastral surveys in the agricultural provinces has also had to be met by the Survey Department.

So it has happened that patches of accurate work have been scattered about all over the country. It is intended gradually to complete the connection between these isolated patches of triangulation and lines of latitudes and azimuths, as opportunity allows.

Primarily, however, the energies of the Department will be spent in meeting the local requirements.

For the present the errors that exist will be left to be absorbed in the desert, and in the meantime provisional issues of sheets in the form of sun prints compiled from sketches of varying degrees of accuracy will be available.

These sheets are issued for local use in the hopes that they will be freely criticised. Eventually by means of constant revision fairly reliable maps of all parts of the Sudan should be possible long before a systematic survey embracing the whole country could be seriously considered.

(ii.) Work during Season 1906–1907.

Cadastral Surveys.

Dongola Province.—Survey of cultivated land entirely completed on 1 : 2,500 scale. Area surveyed about 150,000 feddans. This survey was commenced in 1903. (1 feddan = 1·038 acre).

A reduction of the cadastral survey sheets to a scale of 1 : 50,000 from Abu Fatma to J. Barkal has been completed, giving the first accurate map of the river and islands. This map has been prepared for local requirements only and will not be published, though sun prints can be obtained in Khartoum.

It will be utilised in bringing out a revise of the existing 1 : 250,000 scale maps.

Khartoum Province.—Survey of all cultivated lands completed on 1 : 2,500 scale. Area surveyed 100,000 feddans. The survey was commenced early in 1905.

A key map on the 1 : 50,000 scale as in the case of Dongola is in hand and will be issued for local use during the year.

Berber Province.—The survey of the Shendi and El Bamer districts on the 1 : 2,500 scale comprising an area of about 50,000 has been completed. Survey was commenced, April, 1905.

Berber district is in hand and Abu Hamed will follow.

A key map on the 1 : 50,000 scale of the completed portion of the province is being commenced.

Halfa Province.—The cultivated areas are in small plots with many boundaries scattered among the rocky hills on the banks of the river. Progress is therefore very slow. Commenced in January, 1907, at the time of writing, June, 1907, probably some 7,000 or 8,000 feddans have been surveyed.

On the completion of the work a key map on the 1 : 50,000 scale will be prepared.

Gezira.—The area of the land to be survey is estimated at 3,000,000 feddans. A commencement has been made of the detail survey, and, as a result of the first season's work, roughly, a quarter of a million feddans have been completed. The areas surveyed and in hand are shown on index map No. 3. A framework of minute squares is being laid out on the ground, iron survey beacons with cross vanes, on which are stamped the latitude and longitude, being fixed at each corner.

Sixteen plane-tablers, in four sections, each under an Egyptian sub-overseer, have been employed on the detail work, the whole party being under an English Inspector. The framework of squares enable the parties to be under close supervision, and at the present rate of work it is found that the Inspector can move his own and his four section camps once a week.

The scale adopted is 1 : 4,000, as plane-tables sufficiently large to take a minute square on the 1 : 2,500 scale, would be of too unwieldy a size.

During the season the Department has sustained two very serious losses in the Gezira.

Mr. W. L. Crompton, late of Queensland and of the Gold Coast Survey Department, joined early in 1905.

It was in conjunction with him that the scheme of minute squares for the framework for the Gezira survey was decided on. From the commencement he had been in charge of the work, and it was owing to his experience and ability that the traverse accuracy, essential to the carrying out of the scheme, was arrived

at. The closing errors in the work have, up to date, averaged about 1 in 40,000. Mr. Crompton contracted enteric fever in December in the Gezira, and died in Khartoum in February this year.

Mr. Morrison had hardly joined the Gezira to take charge of the detail survey before he also contracted enteric fever. He died just a week before Mr. Crompton.

White Nile.—Cadastral survey of the wide stretches of land along the banks of the White Nile, uncovered except in the flood, from Khartoum to Goz Abu Guma, has just been commenced. Triangulation from bank to bank (sides 5 to 10 kilometres), with traverses between trig. stations, giving three or four points per square kilometre, is preceding the detail work, which will commence in 1908.

General.—Cadastral survey was commenced in 1903 in the Dongola Province on the initiative of Colonel Jackson, C.B., the Governor of the Province.

Groups of sagia (plots of land cultivated by water-wheels) were allotted to surveyors. The boundaries were then mapped by means of plane-tables, telescopic alidades, and 20 metre chain.

There was no control by either theodolite triangulation or traverse, and the accuracy of the map was entirely dependent on checking in the field.

The urgent need of cadastral survey in other provinces gave no opportunity of control survey being laid down in advance, and the Khartoum and part of Berber Province have been surveyed in the same manner.

All cadastral work now in hand, however, has been preceded by either theodolite triangulation or traverse. The positions of stations have been plotted on to the sheet issued to the detail surveyors, providing mechanical checks on the work.

The areas are being taken out by planimeter and sliding scale separately; if these agree within 1 : 50 of a feddan the mean is accepted.

Cadastral survey maps are not printed; the original remains in the headquarters of the Provinces, one copy is made for the headquarters of the district and another for the Sheikh of the village.

The individual plots probably average 10 feddans in size, and the cost per feddan surveyed works out to roughly 4 p.t. (10*d.*).

(iii.) Native Surveyors.

All plane-tabling is done by natives of the Sudan. On joining the Department from the Gordon College and other

Sudan schools, where they have had some grounding in the theory of the work, they are placed in a survey camp, where they remain for some three months, before being drafted into the field parties.

They show an extraordinary aptitude for this simple plane-table work and maps turned out by boys who have been a year and upwards with the Department are about as good as can be expected with the instruments used.

Their chief fault is carelessness and a tendency to do everything at breakneck pace. A mistake of a chain is more likely to be made than a mistake of a link.

Some few boys have just completed a course at the Gordon College in trigonometry and surveying with level, theodolite, &c. They are the first who have received instruction in any higher survey work and from the examination papers lately sent in, they should prove useful and capable surveyors. The majority of those now employed, however, are not likely to rise beyond sub-overseer of plane-tablers.

Town Survey.—Building land in Khartoum and Omdurman has now risen to such a value that a town survey office has been established during the year, and sheets on the 1:500 scale are being prepared.

Town survey is also in hand at Port Sudan on the same scale, and the survey of part of Halfa town has just been completed.

(iv.) Topography.

Outside the triangulation and theodolite traverses run in connection with the cadastral surveys, some work has been done in the north of the Red Sea Province and in Kordofan.

A triangulation round Kassala was made at the time of delimitation of the Eritrean and Abyssinian boundaries, and this triangulation had been carried up to Suakin.

Last season it was further extended to the north to Mohammed Gul, and work is now in hand with the idea of completing the connection to the north of the 22nd parallel with the Egyptian Survey Department triangulation, and to the west, with the triangulation which was made some years ago round the Murrat Wells.

Later again this triangulation round Murrat Wells will be connected to the Halfa work.

The average triangular error is about 10 seconds and the length of sides from 10 to 20 miles.

In Kordofan a triangulation has just been started to the south of El Obeid, to eventually be connected with Khartoum. The work is, however, in the first instance to be pushed to the south, as a reliable map of Southern Kordofan is urgently required.

Till the present year no maps had been issued of Kordofan and the Bahr-El Ghazal on the 1 : 250,000 scales.

A very large number of sketches, however, had been made in Kordofan by Majors Wilkinson and Leveson, Captains Morant and Lloyd, and many others, and in the Bahr-El Ghazal by the officers of the province.

With the help of some observed latitudes, and a few astronomical positions fixed by the Belgian Mission under Comdt. Lemaire, compilations of the sheets have been made and sun prints issued.

Sheets on the million scale No. 45, 46, 55 and 66 have been published (see Index Diagram). A reduction of the 1 : 250,000 sheets to form sheets 65 and 77 and part of 78 has been made in Khartoum. It is hoped during next year to complete a map of the whole Sudan on the 1 : 1,000,000 scale.

This map will be useful for administrative purposes, but as much of it will have been compiled from route sketches alone, no great reliance can be placed on its accuracy.

(v.) Levelling.

No levelling has been taken up by the Sudan Survey Department. The Egyptian Survey Department has, however, during the last year completed a line of levels along the river as far south as Khartoum.

The irrigation department under Mr. Dupuis has also done a large amount of levelling to the south of Khartoum. On the Blue Nile a line has been run as far as Famaka. From Singa a line goes across to Abu Hashim on the Dinder, and from Sennar, Wad Medani and Kamlin various lines have been run across the Gezira.

On the White Nile continuous lines of levels have been run from Khartoum to Lake No, also from Taufikia to Bor, and again from Taufikia up the Zeraf for about half its length.

In addition Kassala has been connected viâ Gedaref with Mafaza on the Rahad, and it is hoped it will be linked up with the Blue Nile levels next year.

(vi.) Staff.

The British staff of the Survey Department is at present as follows :—

Director of Surveys ... ... Capt. H. D. Pearson, R.E.
Assistant Director of Surveys Lieut. A. E. Coningham, R.E. (employed on topographical work, triangulation of Kordofan)
Mr. R. M. Carson (triangulation north of Red Sea Province.)

Cadastral Survey.

Mr. A. W. Fraser	...	Superintendent, Headquarters, Khartoum.
Mr. S. M. Vines	...	In charge, Gezira minute squares.
Mr. L. Bolton	...	Gezira minute squares.
Mr. Mackenzie	...	Gezira detail survey.
Mr. C. V. Quinlan	...	Halfa control survey.
Mr. L. G. Miles	...	Halfa detail survey.
Mr. C. F. Ryder	...	Berber Province.
Mr. Bevan ...	...	Berber Province.
Mr. Morris ...	...	Berber Province detail survey.

Town Surveys.

Mr. A. A. R. Boyce...	Town Survey, Khartoum.
Mr. Roberts ...	... Assistant Town Survey, Khartoum.
Mr. J. M. Favell	.. Town Survey, Port Sudan.

BRITISH CENTRAL AFRICA PROTECTORATE.

Commissioner ... ... Sir ALFRED SHARPE, K.C.M.G., C.B.

Director of Public Works ... Mr. T. I. BINNIE.
(The Public Works Department undertakes the surveys.)

(i.) *History of the Surveys.*
(ii.) *Existing state of the Maps.*

(i.) HISTORY OF THE SURVEYS.

The following is extracted from a report by Mr. H. R. Wallis :—

The Survey Department of the British Central Africa Administration was created in May, 1895, on the arrival of Mr. Stotesbury from India with three Indian Surveyors and five linesmen.

On Mr. Stotesbury's arrival a base was measured near Chiradzulu, 12 miles north of Blantyre, from which were triangulated the hill peaks round Blantyre.

Surveys and plans of the privately-owned lands in the Shire Highlands were urgently wanted at this time, and the Indian Surveyors and Linesmen at once commenced the work of estate surveying, which occupied the whole Survey Staff until the departure of Mr. Stotesbury from the Protectorate in August, 1896.

In 1897 a skeleton triangulation was pushed on through Cholo to within 12 miles of Chiromo (on the south), and to 15 miles north of Zomba (on the north), and the work of surveying privately-owned lands continued. This is practically all the triangulation work which has been done in the Shire Highlands, and was carried out in order to survey private estates, and not as part of a comprehensive scheme for mapping the Protectorate generally.

After most of the privately-owned lands in the Shire Highlands had been surveyed, demands were made for maps of districts to assist Collectors in district work, and in order to comply with this, Mr. Binnie, the Chief Surveyor, whilst working on the Anglo-Portuguese Provisional Boundary Delimitation in 1899 and 1900, roughly sketched as much country on either side of the boundary line as was possible in the time available, to a scale of 1 : 250,000.

The first concerted scheme for mapping the Protectorate was started in 1903, when the Chief Surveyor, accompanied by two European Surveyors, commenced a comprehensive and systematic survey in the North Nyasa District, to a scale of 1 : 250,000. This work was started from the triangulated bases of the Anglo-German Nyasa-Tanganyika Boundary, information regarding which was supplied by the Director of Military Intelligence. During part of the season of 1903, the three Surveyors triangulated the hill peaks and plane-table surveyed the whole of the North Nyasa District as far south as latitude 11 S. Maps showing this work were published in two sheets, Songwe and Nyika Plateau.

Owing to pressure of work nothing was done in 1904, but during 1905, Mr. Firr, the first Surveyor, now on leave, carried the 1903 work south to latitude 12° 35′ S., with a section roughly 20 miles wide, the work being continued by Mr. Bannerman to latitude 14° S., in connection with the alignment of a trunk road between Dowa and Mzimba.

The Survey Department, in spite of its title, was more occupied with engineering works and land duties than with surveys, and this explains the fact that the mapping of the Protectorate is in an incomplete state. In future the department will be called the Public Works Department, and miscellaneous survey duties will be carried out by a division of the department.

For the present, financial considerations prevent the execution of any systematic trigonometrical survey.

(ii.) Existing State of the Maps.

1. A map on the scale of $\frac{1}{1000000}$ of the whole Protectorate of British Central Africa, on one sheet, has been published.

2. $\frac{1}{250000}$, T.S.G.S., 2 sheets of the northern portion of British Central Africa, including the Anglo-German frontier and the Nyika Plateau, 1904; $\frac{1}{250000}$, T.S.G.S., 9 sheets of the southern portion, including the Anglo-Portuguese frontiers, Lake Shiswa, Zomba and Blantyre, 1901.

There is a gap between these two sets of sheets which should be filled as soon as possible.

3. Maps which are now somewhat out of date (*a*) Shire Highlands, on layer system, scale 5 miles to 1 inch, J. G. Bartholomew, 1897; (*b*) the Shire Highlands, D. L. Beringer, ½ inch to 1 mile, E. Stanford, 1897.

EAST AFRICA PROTECTORATE.

Governor	... ...	Lieutenant-Colonel J. Hayes-Sadler, C.B.
Director of Surveys	... ...	Major G. E. Smith, R.E.
Deputy Director of Surveys	...	Captain G. S. Knox, R.E.
Deputy Director of Surveys	...	Mr. E. L. Waring.
Assistant Director of Surveys	...	Lieutenant E. W. Cox, R.E.

(i.) *History of the Surveys.*
(ii.) *Inspection of Department.*
(iii.) *Staff.*
(iv.) *Work of the past Year.*
(v.) *Present state of the Maps.*

(i.) History of the Surveys.

The present Survey Department was established in April, 1903, as a branch of the Public Works Department. The object of the department was described as being the "surveying plots in the neighbourhood of the railway zone." The staff then consisted of the Chief Surveyor and one Indian clerk, augmented a few months later by the addition of one European assistant. Simultaneously with the creation of the department the advantages of the country for settlement were widely advertised, causing a very large influx of prospective settlers, principally from South Africa.

The Chief Surveyor was in May of 1903 called to combine with his existing duties those of Land Officer. Since no survey

EAST AFRICA.—BEACON, KISII COUNTRY.

existed, and it was imperatively necessary to settle the people on the land advertised as open for selection, every kind of makeshift had to be adopted to meet the situation.

In 1904 the staff was augmented by the addition of six Europeans.

Outside surveyors were licensed, but as no framework existed, it was impossible to check their work.

The Chief Surveyor recommended in 1903 the execution of a trigonometrical survey; it is unfortunate that this recommendation was not at once acted upon. Much wasteful expenditure was incurred and the settlers had legitimate grievances against the Government.

In 1905 the Commissioner appointed a Land Commission to enquire into the whole question of land in the Protectorate. The Commission reported as follows:—

"The absence of survey has led from one difficulty to another. The land in some districts is said to have been applied for many times over, other districts partially settled have been closed for further settlement, other districts, again, have not been opened for settlement at all, and in no case is the Government able to proceed either with the work of getting rid of arrears of applications which have accumulated during the last two years or of turning its attention to the throwing open of uncultivated districts for settlement. As a consequence the general development of the country has received a severe check.

"The necessity of seriously and at once, dealing with the question of survey cannot be over-estimated. The present system of survey, if, indeed, it can be called a system, ... is both expensive and of comparatively little value."

In May, 1905, the Secretary of State for the Colonies directed Major G. E. Smith of the Anglo-German Boundary Commission to investigate and report upon the surveys of the Protectorate.

In Major Smith's report, which is dated the 30th July, 1905, it is pointed out that the average time which elapsed between the date of application for a grant of land and the date of registry was 12·6 months, a delay which was a cause of considerable hardship to settlers of small means.

The department was strengthened and reorganized in April, 1906. The Land Department was separated from the Survey Department. Major G. E. Smith was appointed Director of Surveys, and Mr. Barton Wright, formerly Chief Surveyor, was appointed Chief Land Officer. It is intended that each department shall be under the general administration of the Land Board, of which the Directors are to be members, with those of the departments of Agriculture and Forests, Lieut.-Colonel J. A. L. Montgomery, C.S.I., being President.

(ii.) Inspection of the Department.

It is realized by the Colonial Survey Committee that it is not possible to give satisfactory advice regarding the administration of the various survey departments of the Crown Colonies and Protectorates scattered throughout the world, nor to judge of the reasonableness of estimates and efficiency of technical methods, without occasional independent inspection. For this purpose the Secretary of State for the Colonies deputed Major E. H. Hills, C.M.G., to report upon the surveys of East Africa, Uganda, Ceylon, and the Federated Malay States.

Major Hills inspected the Survey Department, and submitted a report dated 21st February, 1907. The report gives a generally favourable impression of the progress of the department, especially as regards the trigonometrical work. The cadastral work requires further systematizing and accelerating. Major Hills points out that it is unwise to insist on a very high degree of precision in cadastral maps which are urgently required, and the Colonial Survey Committee concur in this view.

(iii.) Staff.

The present staff of the Survey Department consists of :—

Superintending Staff.

Director of Surveys.	1 Clerk.

Trigonometrical Branch.

Deputy Director.	2 Surveyors.
Assistant Director.	Native Artizans.

Cadastral Branch.

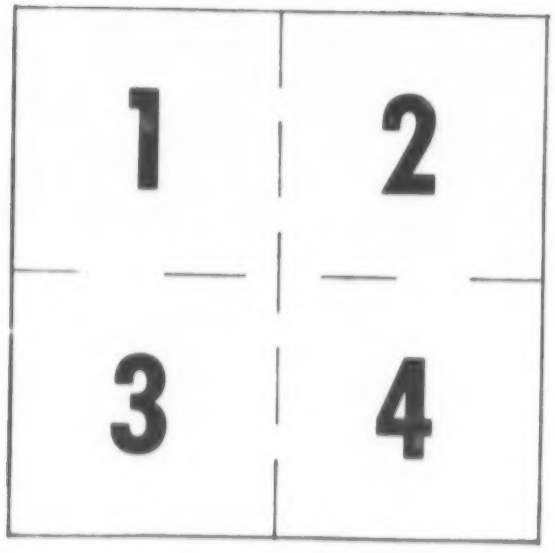
Deputy Director.	1 Plan Examiner.
Assistant Director.	4 Draughtsmen.
5 Surveyors.	5 Indian Surveyors.

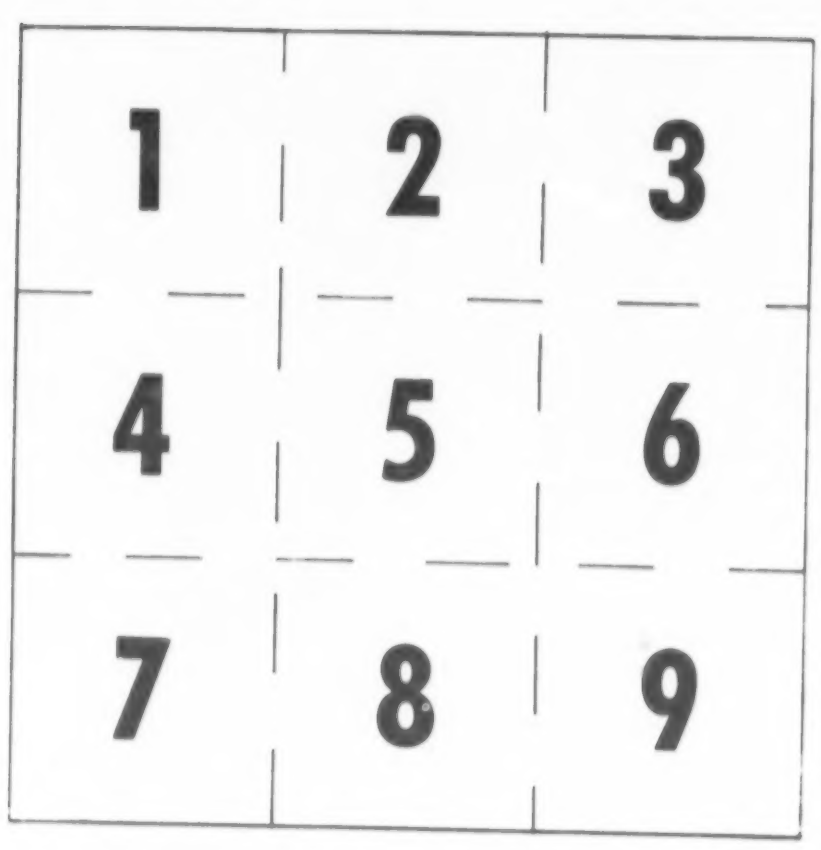
(iv.) The Work of the past Year.

Trigonometrical Branch.—A base has been measured on the Athi plains, and a trigonometrical connection has been made with the Boundary Commission chain of triangles to the south of it. As the latter is connected with Zanzibar, of which the longitude has been determined by exchange of telegraphic signals with the Cape, the Athi triangulation depends for its longitude on the Cape and indirectly on Greenwich.

A triangulation has been carried out in the Sotik country. This triangulation is connected with the boundary triangulation

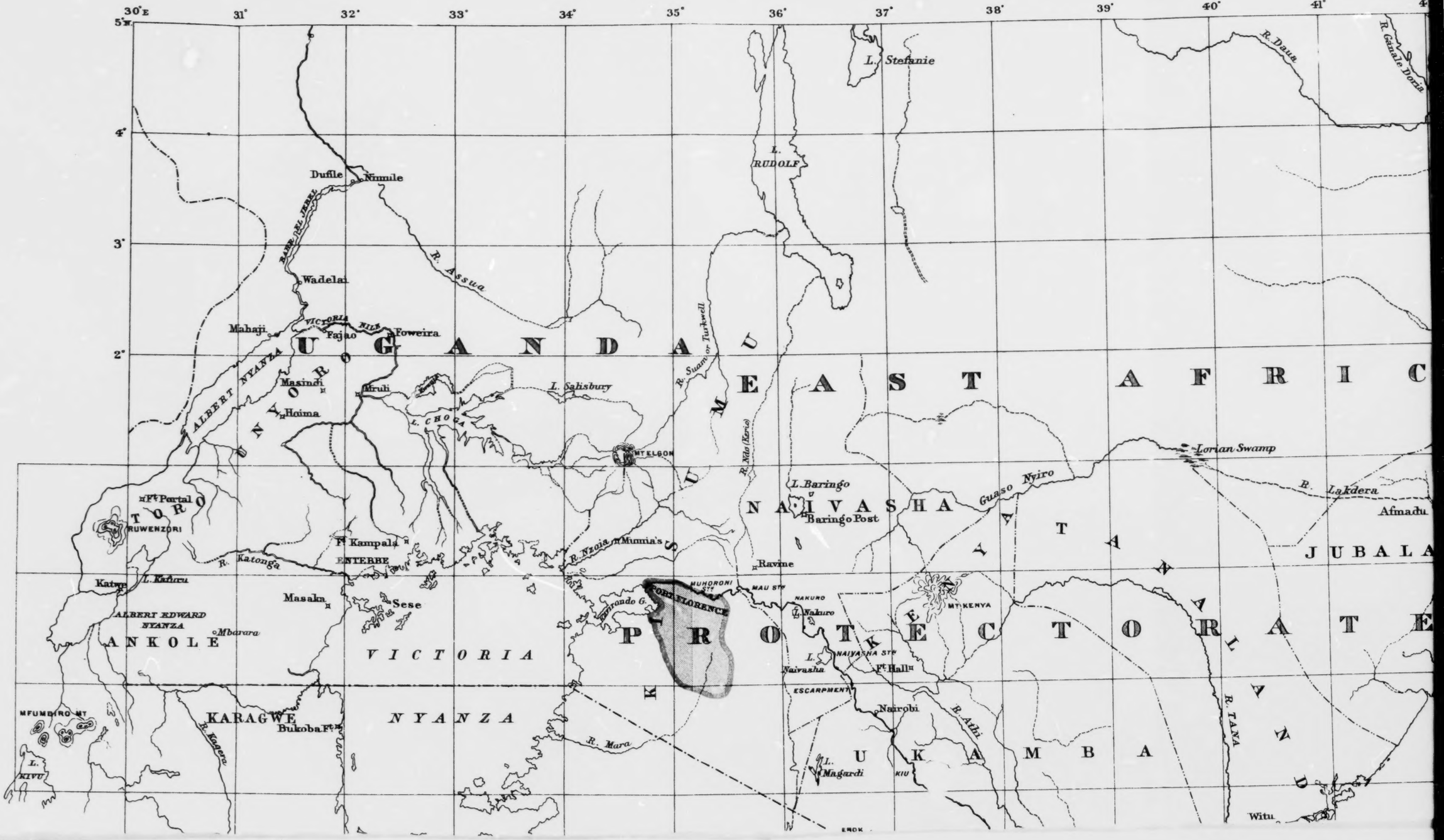
Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





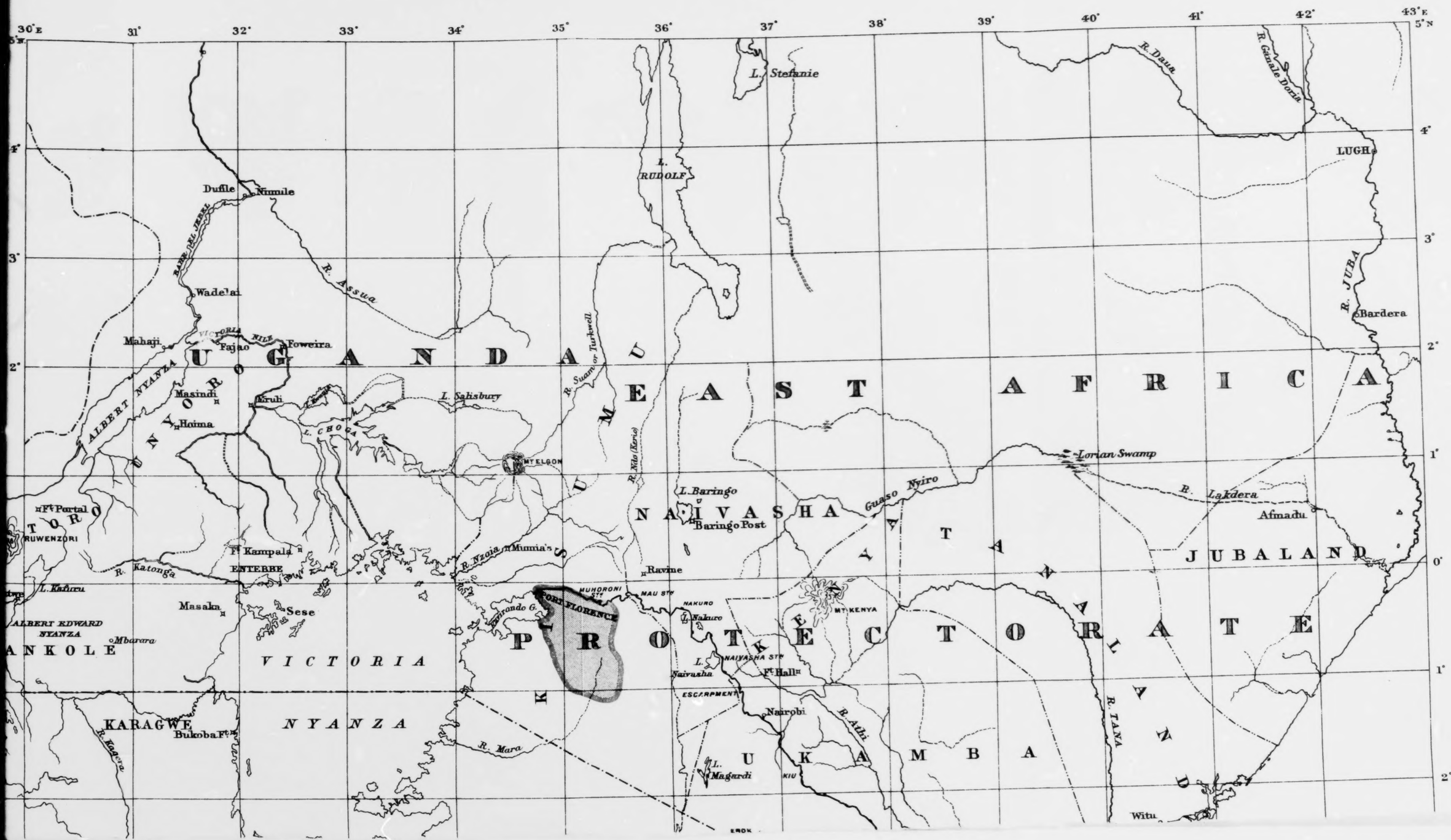
INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA

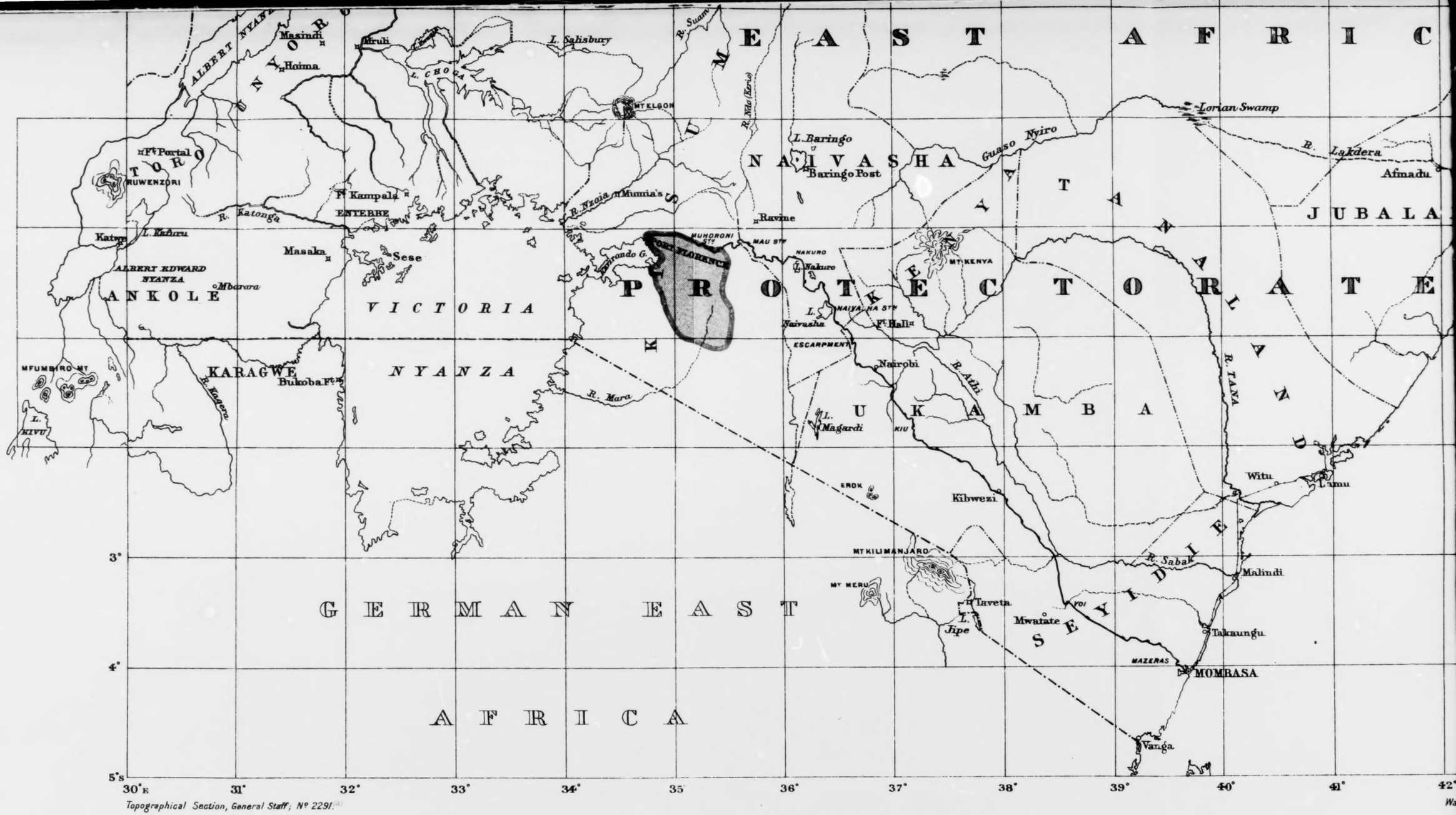


INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA



EAST AFRICA PROTECTORATE



Topographical Section, General Staff; No 2291.

Scale $\frac{1}{4,000,000}$ or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

Topography at 1:2°000 completed and published

EAST AFRICA

PROTECTORATE

GERMAN EAST AFRICA

Masindi
Hoima
Mruli
L. Salisbury
L. CHOGA
MT ELGON
R. Sua
R. Nzoia
Mumia's
R. Nzoia
R. Ndo (Koris)
L. Baringo
Baringo Post
NAIVASHA
Guaso Nyiro
Lorian Swamp
R. Lakdera
Afmadu
JUBALAND
Ravine
Ft Portal
TORO
RUWENZORI
Ft Kampala
ENTEBBE
R. Katonga
L. Katwe
Masaka
Sese
ALBERT EDWARD NYANZA
NKOLE
Mbarara
VICTORIA NYANZA
KARAGWE
Bukoba Ft.
R. Kagera
R. Mara
MUHORONI STN
FORT FLORENCE
Eldoret
MAU STN
NAKURO
L. Nakuro
MT KENYA
L. NAIVASHA STN
Naivasha
Ft Hall
ESCARPMENT
Nairobi
R. Athi
L. Magardi
KIU
UKAMBA
R. TANA
EROK
Kibwezi
Witu
Lamu
MT KILIMANJARO
MT MERU
R. Sabaki
Malindi
Taveta
L. Jipe
Mwaiate
VOI
SEYDIE
Takaungu
MAZERAS
MOMBASA
Vanga

30° E 31° 32° 33° 34° 35° 36° 37° 38° 39° 40° 41° 42° 43° E
1° 0° 1° 2° 3° 4° 5° S

Topographical Section, General Staff; No 2291.(a)

War Office, July, 1907.

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

Topography at 1:250,000 completed and published

at Kisumu. The triangular error of the main triangles was 2″.4, and of the minor triangles 3″.2. The work was thoroughly well executed. A map, on a scale $\frac{1}{250000}$, of an area of 2,393 square miles of the Sotik region was also executed. This must not be considered a rigorous topographical map, but is a good specimen of geographical reconnaissance.

An office and store has been built for the Trigonometrical Branch.

As regards the *Cadastral Surveys*, the aggregate area of land surveyed during the year for the purpose of land conveyancing was 870,265 acres, and a total of 316 applications for various areas of land have been dealt with.

Cadastral sheets of Nairobi and Mombasa, on a scale of $\frac{1}{2500}$, have been commenced, and 23 are approaching completion. 20 farms, averaging 5,000 acres in area, have been laid out in Sotik.

The following is a statement of surveys effected for the conveyancing of property during the past three years :—

Year.	Agricultural Lands.	Grazing Lands.	Forest Lands.	Fibre and Cotton Lands.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.
1904–05	49,740	526,802	10,000	32,000	618,542
1905–06	23,277	399,413	220,869	101,974	745,533
1906–07	9,667	519,914	64,320	276,366	870,267

Considerable improvements, designed by Mr. Waring, have been effected in the temporary headquarters' offices at Nairobi. These provide increased facilities for carrying on the office work, and also allow of the admission of the public to a public map office for the purpose of inspecting and examining plans and maps.

A permanent branch and survey office has also been built at Mombasa.

(v.) Present State of the Maps.

The only accurate topographical maps of the Protectorate are those of the Anglo-German Boundary zone, on a scale of $\frac{1}{100000}$. There are 7 of these sheets, and the zone extends from Victoria Nyanza to Kilimanjaro, and from that mountain to Lake Jipe. The width of the zone surveyed is about 20 miles, and the work is excellent and accurate.

A geographical map of the Sotik country has been published on a scale of $\frac{1}{250000}$.

Of compilation maps there are the following:—

Scale $\frac{1}{1000000}$ 3 sheets, T.S.G.S.

„ $\frac{1}{1000000}$, sheet 93, is in preparation, also a new edition of sheet 94.

„ $\frac{1}{250000}$ 15 sheets, T.S.G.S.

(vi.) FINANCIAL.

The estimated cost of the Survey Department for 1907-8 is about £19,000 and of the Land Office £5,300.

THE GAMBIA.

Governor ... ... Sir G. DENTON, K.C.M.G.

The Gambia consists of a strip of territory about 185 miles long extending up the River Gambia from its mouth, enclosed north, south and east by French territory. The international frontier is defined principally by two parallels 26 minutes apart in the western portion, and in the eastern portion follows the river at a distance of 10 kilometres from the banks.

The map produced by Major E. L. Cowie, who was in charge of the British party of the Boundary Commission of 1904–05, covers the whole of the Colony and Protectorate as far as 13° 45′ W. It is on a scale of $\frac{1}{250000}$ (1·014 inch to 4 miles), is in two sheets, and is printed in colours. (T.S.G.S., No. 1958).

There is no need for a survey department, and for the present the Gambia has been sufficiently well mapped.

THE GOLD COAST.

Governor ... ... Sir JOHN RODGER, K.C.M.G.
Director of Surveys... ... Major F. G. GUGGISBERG, R.E.
Assistant Director of Surveys Capt. C. B. O. SYMONS, R.E.

(i.) *Historical Sketch.*
(ii.) *Methods of Survey Adopted.*
(iii.) *The Staff of the Survey.*
(iv.) *The Season's Work.*
(v.) *Existing State of the Maps.*
(vi.) *Financial.*
(vii.) *General Results.*

(i.) HISTORICAL SKETCH.

A rigorous survey of the Gold Coast Colony was rendered necessary in 1901, on account of the large number of gold mining concessions taken up by companies.

EAST AFRICA.—OFFICE OF TRIGONOMETRICAL BRANCH, NAIROBI

In the middle of 1901, Major Watherston, R.E., Director of Surveys, brought out a small party of Royal Engineer officers, non-commissioned officers, and sappers, laid down several long traverse lines on which to base the survey of the concessions, and cut one or two concession boundaries, in order to obtain a basis on which to determine fair survey fees for boundary cutting.

In October, 1902, a large party of Royal Engineer officers and men, and Queensland and New Zealand surveyors, landed at Sekondi.

During the three seasons, 1902–3, 1903–4, and 1904–5 upwards of 300 concessions were cut, and the country covered with a network of long traverses.

In 1903–4 Captain Guggisberg, R.E., with the Zenith Telescope, determined accurate latitudes at different points in the network. In 1904–5 Major Watherston determined the longitude of Accra by cable with Cape Town, and handed over the Directorship of the survey to Major Guggisberg.

In 1904–5, the survey of Ashanti concessions was started.

The Gold Coast Survey differs from the majority of other Surveys in Tropical Africa, owing to the fact that the mining concessions necessitate the addition of a considerable amount of financial work to the ordinary technical work of a survey.

(ii.) Methods of Survey Adopted.

(*a*) The whole of the Gold Coast Colony and a part of Ashanti are covered with a network of traverses from 4° 45′ north to 6° 45′ north, and 1° 12′ east to 2° 47′ west.

(*b*) These traverses are rigidly surveyed with theodolite and steel tape. Their execution necessitated continual cutting through the forest, which covers the whole country, except that portion between Accra and the Volta River below about 6° 5′ north.

The legs of the traverses were necessarily short, owing to the dense tangled bush. The trees of the forest average about 180 feet in height, and the undergrowth runs up to about 60 feet. The labour of cutting kept the average length of legs at about 400 feet, though this varied locally accordingly to the nature of the country.

(*c*) At every three to five miles "Permanent Marks," with a distinguishing number, are erected to serve as beacons, and to preserve the azimuth observed at them.

(*d*) Angular measurements in the traverse are corrected at about every five to ten miles of traverse by observed azimuths.

From one to two seconds of arc per leg was about the average correction found to be necessary.

(*e*) Latitudes are observed with the Zenith telescope on Talcott's system at stations about 50 miles apart in latitude.

The comparison of astronomical and traverse differences of latitudes have shown, on the whole, excellent results.

(*f*) Measurements are further checked by closing the traverses, and the results of these closures form a further proof of the accuracy of the survey. One figure with a traversed perimeter of 320 miles closed to within 300 feet, or an error of $\frac{1}{5632}$, and generally the closing error proved to be between $\frac{1}{2000}$ and $\frac{1}{5000}$.

(*g*) The dense nature of the forest is against the trigonometrical determination of heights, as nowhere can a view be obtained of any importance, and but few hills exist of over 1,000 feet. Also, the necessity of pushing on the general survey as rapidly as possible, consistent with the accuracy of horizontal work, in order to allow the full strength of the survey staff being employed on concession work, has made it impossible to run lines of levels.

A rough system of running the height through from the origin has been adopted, but the results have not yet been worked out.

(*h*) Inside the network of traverse lines the detail of the country has been filled in chiefly by compass sketches fitted to fixed points on the rigid survey, but in certain parts the survey of the mining concessions has blocked in the areas between the traverses.

(iii.) The Staff of the Survey.

The strength of the staff of the Gold Coast Survey was considerably reduced before field operations were commenced in July, 1906. During the year under review (1906-07) it consisted of:—

Major Guggisberg, R.E., Director.
Captain C. B. O. Symons, R.E., Assistant Director.
4 Non-commissioned Officers, R.E.
3 Native Assistant Surveyors.
1 Native Draughtsman.

The reason for the reduction was that the work of marking out mining concessions was approaching completion.

(iv.) The Season's Work (1906-07).

(*a*) *Cadastral Work.*—Nine mining concessions were marked out and one township.

(*b*) *Topographical Work.*—Areas in the Accra, Winneha Okwawo, Eastern Akyem, and Saltpond Districts have been

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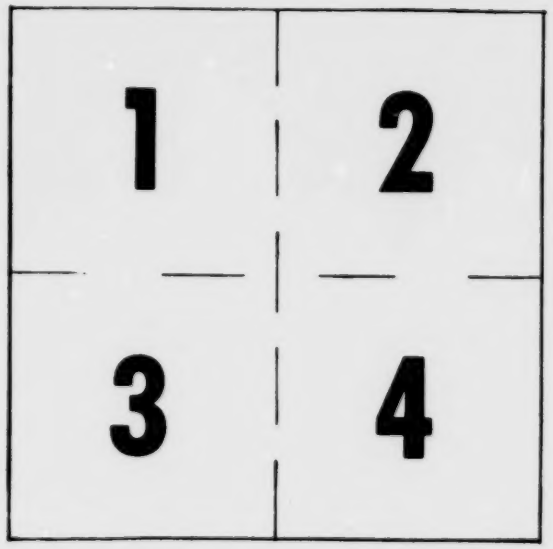
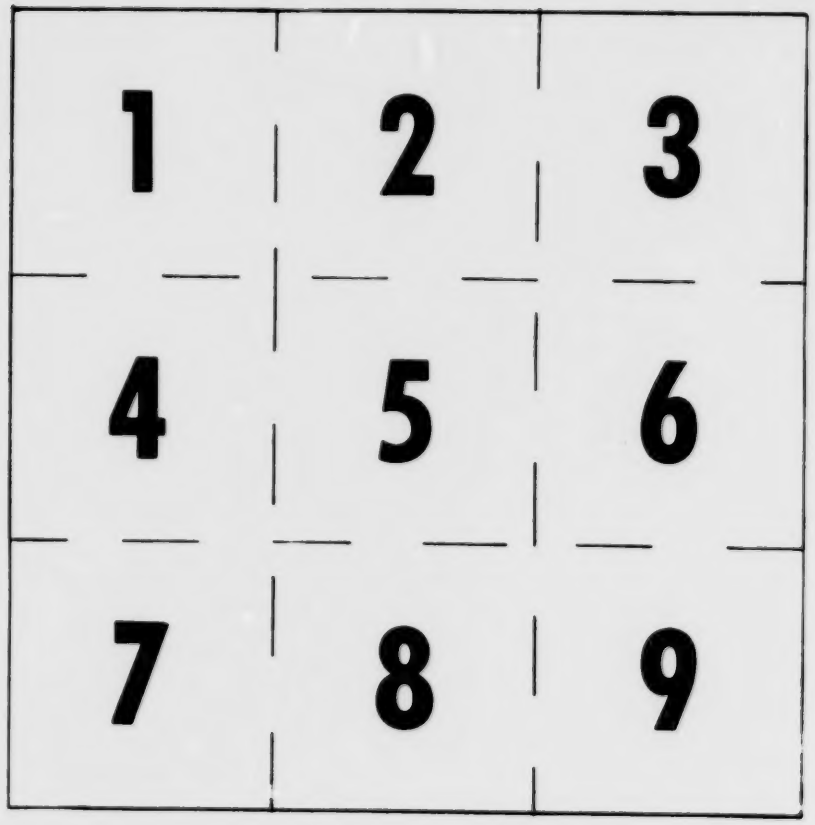
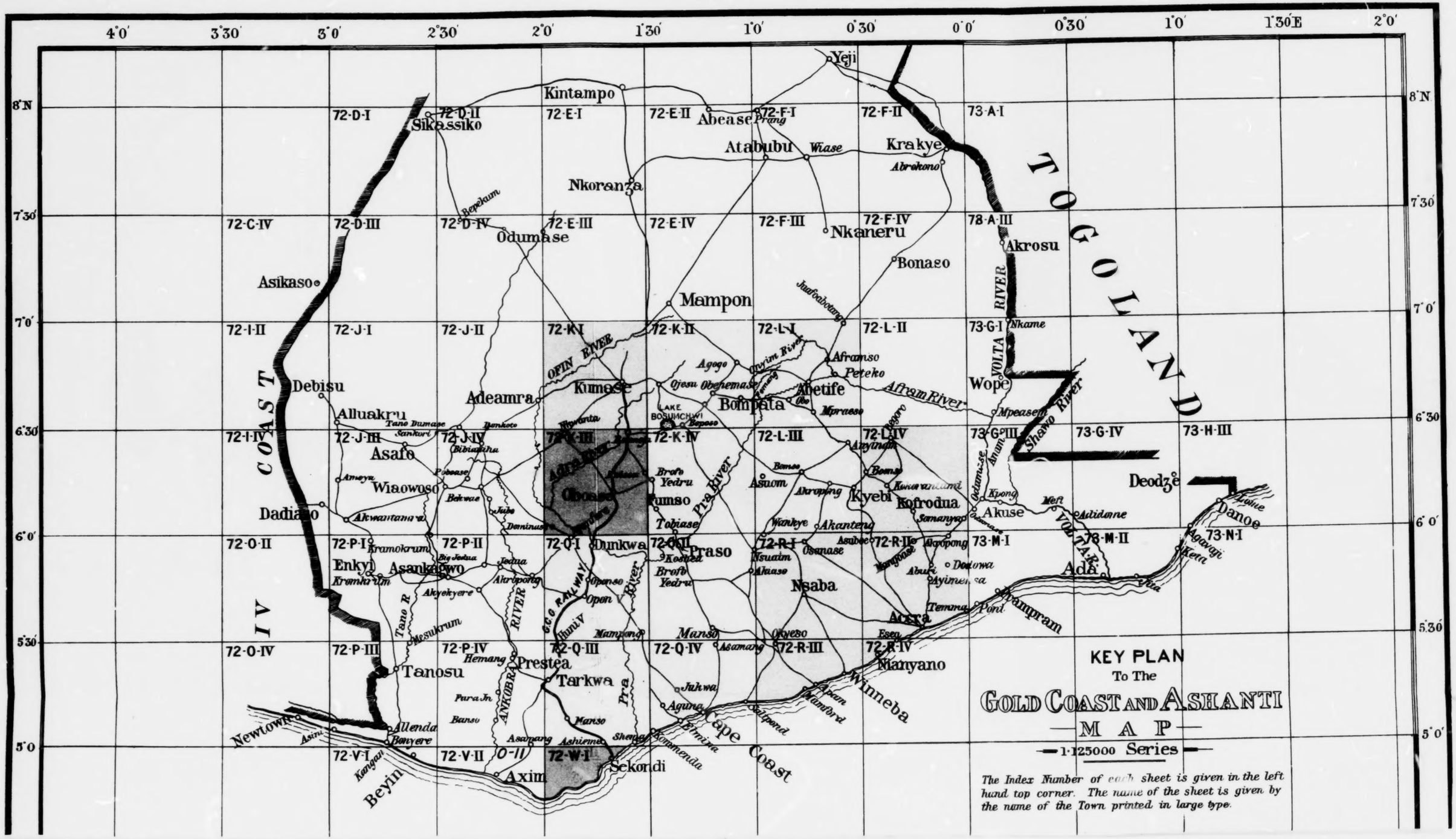




GOLD COAST



KEY PLAN
To The
GOLD COAST AND ASHANTI
— M A P —
1·125000 Series

The Index Number of each sheet is given in the left hand top corner. The name of the sheet is given by the name of the Town printed in large type.

KEY PLAN
To The
GOLD COAST AND ASHANTI
—MAP—
1·125000 Series

The Index Number of each sheet is given in the left hand top corner. The name of the sheet is given by the name of the Town printed in large type.

1·125,000 Sheets in progress in the field
under publication

T.S.G.S., No. 2210.

War Office, July 1907.

mapped by filling in with compass and steel tape between the traverse lines.

In Northern Ashanti a framework of traverses has been executed, and on this the sketches of civil and military officers will be fitted to form the map of this region.

About 3,000 square miles of country between 0° 0′ and 1° 15′ W. and 5° 30′ and 6° 30′ N. were blocked in by secondary compass traverses by Native Assistant Surveyors Smith and Vaughan.

(v.) Existing State of the Maps of the Colony.

The $\frac{1}{125000}$ *Map* (1·014 *inches* = 2 *miles*).—This map will cover the Colony and Ashanti in 36 sheets, but owing to certain parts of the country to the north of Kumase being devoid of mining concessions and sparsely inhabited, it is considered that a map on such a large scale is not necessary for those regions.

The sheets are being produced entirely by the Gold Coast Survey, the drawing being done by the staff and the production paid for out of that portion of the Colonial funds allotted to the vote on map production. Profits from the sale will go to the Colonial revenue. The map is in four colours and is the standard topographical map of the Gold Coast.

Each sheet is 30 minutes square, and a full sheet embraces an area of about 1,180 square miles.

The attached diagram shows the state of the work.

A total area of about 16,000 square miles has been surveyed.

At the present moment (June, 1907) two sheets have been published, five are in the hands of the engravers, and seven are being completed in the field.

The $\frac{1}{250000}$ *map* (1·014 *inches* = 4 *miles*).—This is part of the War Office Series. The existing sheets are compilations of material collected before the publication of any Gold Coast Survey sheets. Future sheets will be based on the latter when available.

A $\frac{1}{1000000}$ *Map* of the Gold Coast and Ashanti has been published during the year by the Topographical Section, G.S. (T.S.G.S. No. 2,204).

A map on the scale of 100 *miles to* 1 *inch* (T.S.G.S. No. 1,955) has been published. This is a general map of the Gold Coast and neighbouring territories.

(vi.) Financial.

From 1901 to 31st December, 1905, the total expenditure on the Gold Coast Survey amounted to £115,000. Of this £40,000 was recovered in survey fees, showing an average net annual expenditure of £18,750.

The net expenditure (excess of expenses over revenue) for 1906–07 was estimated at £10,000. For 1907–08 the net expenditure is estimated at £2,500.

(vii.) General Result.

The bulk of the survey, both cadastral and topographical is approaching completion, and it will be possible to reduce the staff of the department still further in the next season. The work executed has been of a high order of accuracy, and the out-turn has been good. Major Guggisberg has carried out the survey of the Colony in a very efficient manner.

NORTHERN NIGERIA.

High Commissioner:
Lieut.-Colonel Sir Percy Girouard, K.C.M.G., D.S.O., R.E.

(i.) *Sketches.*
(ii.) *Boundary Commissions.*
(iii.) *Longitude Expedition.*
(iv.) *Existing State of the Maps.*

There is no survey department. The existing maps are chiefly compiled from sketches made by civil and military officers while travelling on duty.

(i.) Sketches.

During the past year a considerable number of good sketches have been received.

A triangulation has been suggested in the parts suited to such work, and it is hoped that this may be carried out by local officers.

The value of the sketches would then be much enhanced.

(ii.) Boundary Commissions.

The frontiers of Northern Nigeria have been delimited as follows:—

The Western boundary by a mixed Anglo-French Commission in 1900. Major J. I. Lang (now Lang-Hyde) was British Commissioner.

The Northern boundary by a mixed Anglo-French Commission in 1902–04. Lt.-Colonel G. S. Mc D. Elliot, R.E., was British Commissioner,

This frontier became obsolete owing to the Anglo-French Agreement of May 29th, 1906, and the line thus agreed upon is now being beaconed by a mixed Commission, of which Major R. A. P. O'Shee, R.E., is the British Commissioner.

The northern portion of the Eastern boundary by a mixed Anglo-German Commission in 1903–04. Lt.-Colonel L. C. Jackson, R.E., was British Commissioner.

The portion of the Eastern boundary from the sea to the neighbourhood of the rapids of the Cross River by a mixed Commission in 1905–6, of which Captain A. J. Woodroffe, R.E., was British Commissioner.

The delimitation of the remaining portion of this boundary between Yola and the Cross River will be commenced by a mixed Commission this autumn.

(iii.) Longitude Expedition.

In 1905–6, an expedition, under Captain R. Ommanney, R.E., fixed, by exchange of telegraphic signals, the longitudes with reference to Lagos, of fifteen towns.

The construction of the telegraphs in the Protectorate was so far advanced that Sir Frederick Lugard suggested the dispatch of an expedition to determine the geographical positions of a number of points evenly distributed throughout Nigeria.

The results of this expedition will enable good use to be made of the numerous sketches executed by local civil and military officers, and will permit the compilation from them of a fairly accurate map.

The expedition consisted of Captain R. Ommanney, R.E., and Captain G. F. Evans, R.E., who were assisted while in the colony by two officers of the West African Frontier Force.

The expedition was divided into two parties, each of which was accompanied by a telegraph clerk and was provided with the necessary apparatus.

The astronomical observations were made with 6″ theodolites.

The two parties followed each other from post to post, commencing at Lagos, so as to determine the differences in longitude of each successive section of the line.

Captain Evans' party were in front on the first few sections, while on the latter sections Captain Ommanney was in front; in this way the cumulative effect of personal error was avoided.

The determination of the difference of longitude between the ends of each section was effected in three nights' work, during each of which two pairs of time stars were first observed, two sets of telegraphic signals were sent each way, and then two more pairs of time stars were observed.

The latitude of each station was observed, and a permanent mark made at each observation spot.

From Lagos to Zungeru the sounder was used, but after that the state of the lines made this impossible, and the buzzer had to be substituted for it in the later telegraphic exchanges.

Sir Frederick Lugard lent the services of Mr. James Scott, who formed a third party for a short time, and thus enabled several more positions to be fixed than would otherwise have been possible in the short time the expedition had at its disposal.

The rising at Sokoto caused a loss of time of about three weeks.

Mr. C. T. Temple carried out the observations at Kano.

The telegraph lines did not permit the observations being made into a closed circuit; the arrangement will be seen on the accompanying outline map on which the stations fixed and the lines connecting them are shown.

Fifteen main towns were fixed in latitude and longitude, with an *estimated* probable error not exceeding 1 second of time in longitude and about 0·7″ of arc in latitude.

A table of results is appended with the addition of some points fixed by the Anglo-French Boundary Commission by absolute methods.

The cost of the expedition was about £1,300, excluding cost of officers' pay and the salaries of the telegraph clerks employed.

The expedition received very ready assistance from all officials both in N. and S. Nigeria.

The help given by the Lagos Government Railway Department and Lagos Public Works Department was invaluable, while the Postmaster General (Northern Nigeria) and the Marine Superintendent aided materially.

The expedition was admirably organized by Captain Ommanney, and both he and Captain Evans are to be congratulated upon its complete success.

(iv.) The Existing State of the Maps.

The published maps have all been compiled in the Topographical Section of the General Staff. This system of compiling maps at home does not lead to the best results, but owing to the non-existence of any local department it is the only method of producing any maps at all.

Maps on the scale of $\frac{1}{1000000}$ and $\frac{1}{250000}$ covering the whole of Northern Nigeria have been published.

Those on the scale of $\frac{1}{1000000}$ are out of date, being based on the early work, and some 25 sheets of the $\frac{1}{250000}$ series are in want of total revision, to bring them into accordance with the results ascertained by Captain Ommanney's expedition.

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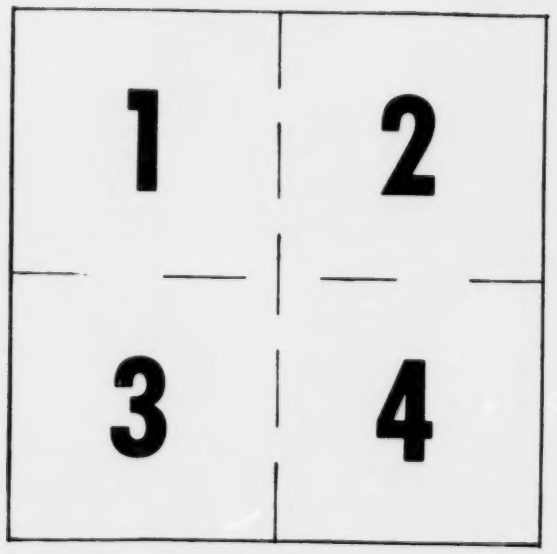
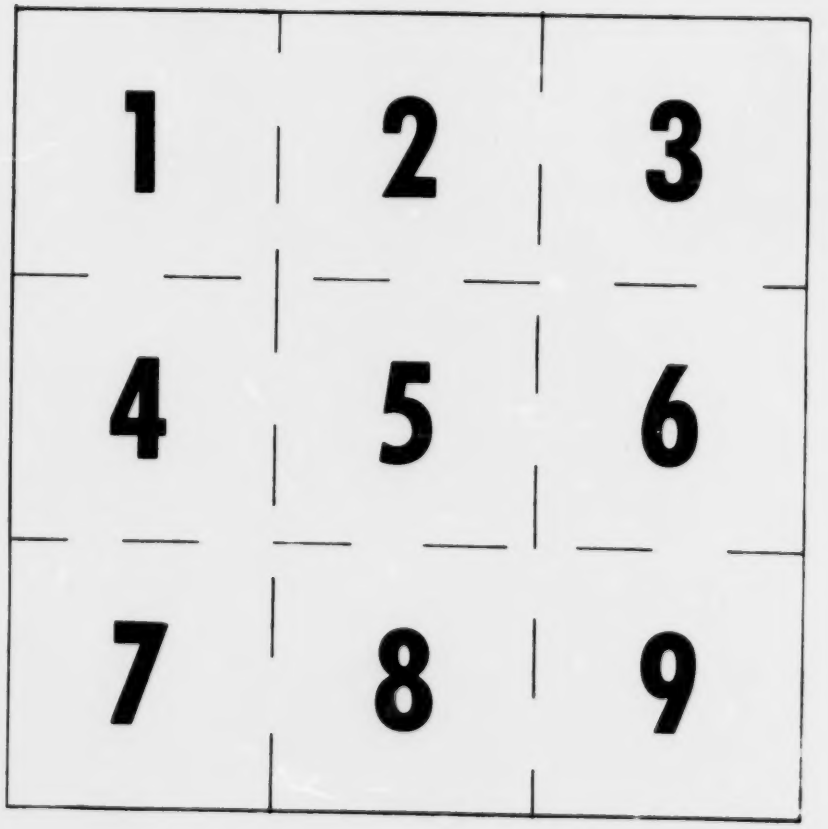




5° E.

10°

N. 10°

10° N.

5°

5° E.

10°

Ilella

Busa

Tcharu

Matankari

Konni

Dantudu

Kania

L. CHAD

Daura

Maikouri

Sokoto

Bebei

Katsena

Jungu

Argungu

Birnin Kuka

Hadeija

Dumjiri

Kukuwa

Yelluˊ

Katagum

R. NIGER

Kano

Maifoni

Zaria

Yelwa

NORTHERN NIGERIA

Leri

Bauchi

Bussa

Kontagora

Zungeru

Jebba

Bida

Keffi

Patigi

Amar

Yola

Ilorin

Loko

Ibi

Lokoja

R. Benue

Ibadan

SOUTHERN NIGERIA

LAGOS

Benin

Calabar

(By chronometer journeys)

Akassa

Telegraphs used in determining positions shewn.

TS. G.S. N°2282

Printed at the Ordnance Survey Office Southampton 1917

DIAGRAM OF POSITIONS IN NIGERIA

fixed both in latitude & longitude.

Scale 6.000000 or 1·014 Inches to 96 Miles

Miles 50 0 50 100 150 200 Miles

LONG: BY TELEGRAPH ⊠

" " ABSOLUTE METHODS Φ

LIST OF POSITIONS.

	Latitude.	Longitude.
Argungu	12° 44′ 35″ N.	4° 30′ 59″ E.
Bauchi	10 18 54·08 N.	9 49 37·56 E.
Bebei	12 38 44 N.	5 54 19·6 E.
Birnin Kuka	12 27 01 N.	9 28 20 E.
Bussa	10 05 24 N.	4 30 29 E.
Dantudu	13 40 27 N.	7 04 38·1 E.
Daura	13 30 16 N.	8 34 16 E.
Ibadan	7 23 10·41 N.	3 52 41·28 E.
Ibi	8 10 48·76 N.	9 44 10·93 E.
Ilella	14 27 47·6 N.	5 15 27 E.
Ilorin	8 30 38·77 N.	4 34 53·90 E.
Jebba	9 07 44·92 N.	4 49 08·36 E.
Jungu	12 27 2 N.	3 31 49·4 E.
Kano	12 00 1½ N.	8 32 43·29 E.
Kania	13 48 43·21 N.	11 10 34·9 E.
Katsena	13 00 13·76 N.	7 41 40 E.
Keffi	8 50 34·29 N.	7 51 54·48 E.
Konni	13 47 37 N.	5 15 48 E.

	Latitude.	Longitude.
Kontagora	10° 23′ 34″ N.	5° 28′ 23·16″ E.
Kukawa	13 55 13·6 N.	13 34 41·1 E.
Lari	10 33 10·26 N.	8 34 19·00 E.
Leko	7 58 31·5 N.	7 48 51·23 E.
Lokoja	7 48 1·2 N.	6 44 23·93 E.
Maikouri	13 13 48·75 N.	8 57 09·45 E.
Matankari	13 45 41·7 N.	5 50 05·5 E.
Calabar (Garden House)	4 57 36 N.	8 19 05 E.
Patigi	8 44 5·78 N.	5 45 38·05 E.
Sokoto (Residency)	13 02 10 N.	5 14 46·9 E.
Tchara	14 04 08 N.	6 02 42 E.
Yelluˊ	12 15 37 N.	3 34 45 E.
Yelwa	10 51 03 N.	4 44 10·43 E.
Yola	9 13 38·9 N.	12 29 30 E.
Zaria	11 06 10·36 N.	7 42 57·44 E.
Zungeru	9 48 32·4 N.	6 09 49·76 E.

LAGOS (Observatory) { Lat. 6° 26′ 38·6 N, Long. 3° 23′ 49·83 E } Fundamental value (telegraph) from Cape Observatory

Telegraphic Longitudes.

Summary of Results.

Place.	Latitude, N.	Longitude, E.	Height above M.S.L.
	° ′ ″	° ′ ″	
Bauchi	10 18 54·66	9 49 27·55	2,260 feet.
Ibadan	7 23 10·41	3 52 41·38	800 „
Ibi	8 10 45·76	9 44 10·83	580 „
Illorin	8 30 26·77	4 34 53·90	1,080 „
Jebba	9 07 44·92	4 49 02·25	430 „
Kano	12 00 12·00	8 32 42·29	—
Keffi	8 50 34·29	7 51 54·48	1,290 feet.
Kontagora	10 23 34·00	5 29 22·16	—
Leri	10 23 16·26	8 34 19·00	2,670 feet.
Loko	7 59 51·5	7 49 51·23	350 „
Lokoja	7 48 01·2	6 44 22·95	320 „
Patigi	8 44 05·76	5 45 28·05	490 „
Yelwa	10 51 03·00	4 44 10·43	—
Zaria	11 06 10·38	7 42 57·44	2,230 feet.
Zungeru	9 48 32·4	6 09 42·26	530 „

The above longitudes were all determined telegraphically.

The heights are arrived at by combining hypsometer observations at each station with relative values obtained by readings of aneroid barometers.

List of Reliable Determinations of Longitude in and near Nigeria (other than Telegraphic).

Place.	Latitude, N.	Longitude, E.	Remarks. Determination of Position and place of Observation.
	° ′ ″	° ′ ″	
Argungu ...	12 44 35	4 30 29	3 occultations. S.E. gate.
Beibei* ...	12 52 44	3 54 19·5	Edge of cliff 1,000 yards S. of town.
Birnin Kuka	12 27 01	3 58 39	2 occultations. East gate.
Busa	14 25 24	6 04 28·5	2 occultations. Camp N. of French post.
Dantudu ...	13 40 27	7 04 38·1	1 occultation.
Daura ...	13 02 16	8 24 16	1 occultation and watches from Katsena. Camp East gate of town.

* These places are connected by a line of latitudes and azimuths.

Place.	Latitude, N.			Longitude, E.			Remarks. Determination of Position and place of Observation.
	°	′	″	°	′	″	
Ilella	14	27	47·6	5	15	27	3 occultations. Anglo-French camp.
Junju* ...	12	37	20	3	31	49·4	Hill N.E. of town.
Kania ...	13	48	42·21	11	10	24·9	2 occultations.
Katsena ...	13	00	12·74	7	41	40	1 occultation. Residency.
Konni ...	13	47	37	5	15	48	Latitude and azimuth from Ilella. N.W. corner of town.
Kukuwa ...	12	55	13 8	13	34	41·1	2 occultations. Centre of town agreed on by Commission.
Maikouri ...	13	13	43·75	8	57	06·45	3 occultations.
Matankari* ...	13	45	41·7	3	59	25·5	Big tree near A.-F. camp.
Old Calabar ... (Garden House.)	4	57	36	8	19	05	By transport of chronometer from Lagos.
Sokoto (Residency).	13	02	10	5	14	41·7	12 occultations.
				5	14	46·9	Anglo-French Boundary Commission.
Chara ...	14	04	08	6	02	42	By watches from Busa. N.W. corner of town.
Yellu	12	15	37	3	34	35	Captain Lang, R.E. N.W. corner of town.
Yola	9	12	28·9	12	29	30	Mean of German and British occultations.

* These places are connected by a line of latitudes and azimuths.

Note.—These values are based on the positions of the moon corrected by Greenwich observations.

Note.—Longitude of Kukawa :—

	°	′	″	
Anglo-German Boundary Commission (Yola-Chad) ...	13	34	25·3	mean value.
By two occultations at Kukuwa	13	35	23·8	by Capt. Evans (Anglo-French Boundary Commission).

RHODESIA.

The following account is based on some notes kindly furnished by the Secretary to the British South Africa Company, and an account by Mr. G. T. McCaw, of the Geodetic Survey, North-Eastern Rhodesia.

(i.) *Southern Rhodesia.*
(ii.) *North-Eastern Rhodesia.*
(iii.) *North-Western Rhodesia.*
(iv.) *Existing maps.*

(i.) Southern Rhodesia.

In 1906 the British South Africa Company was approached with a view to enlisting its support in completing the geodetic survey. This survey, as far as it had then been completed, had been carried out at the Company's expense.

A small series of triangles had still to be observed in order to join the Southern Rhodesian points at Gwelo with the Transvaal survey's geodetic points on the Limpopo. The Company granted a sum of £800 towards the cost of this work.

The expedition under Captain H. W. Gordon, R.E., which carried out the work, has now completed its labours at a cost of slightly more than £1,600.

This series connects the Rhodesian geodetic triangles, executed by Mr. Simms in 1905, with the Transvaal, Orange River Colony, and Cape Colony series carried out by Colonel Sir W. G. Morris, R.E.

There is, then, now an unbroken geodetic chain from the Cape to within 70 miles of the south end of Tanganyika or, roughly, 2,000 miles of the meridian are completed.

There is no secondary or minor triangulation in Southern Rhodesia. The farm surveys vary in accuracy from compass survey to the usual cadastral accuracy with chain and theodolite. These surveys are conducted under the Department of Lands by private licensed surveyors.

A compilation of these farm surveys is kept up to date on a scale of 2,000 Cape roods to one inch. 4·74 miles to one inch.

No organised topographical survey has yet been commenced, but a compilation of sketches produced by individual effort of officials, prospectors, and miners in the colony is being made in the Lands Department.

Geographical surveys have been made by the several Boundary Commissions sent out under the Foreign Office to delimit the Anglo-Portugese boundary.

(ii.) North-Eastern Rhodesia.

The geodetic arc has just been carried north to a point about 70 miles south of Kituta, at the southern extremity of Lake Tanganyika, by the expedition under Dr. T. Rubin.

The final calculations of Dr. Rubin's material are now in hand at the Cape Observatory.

This great meridian measurement was the last great public undertaking supported by Mr. Rhodes for the development of Rhodesia. It was just before his death that he promised Sir David Gill that he would find the means for carrying the measurement forward as far as Tanganyika. The British South Africa Company has endeavoured, in spite of the cost, to carry out his wishes.

The geodetic chain in Northern Rhodesia was commenced in 1902 by Dr. Rubin, assisted by Mr. G. Tyrrell McCaw and two assistant surveyors. The work began about latitude 16° 25′ S. (about 50 miles south of the Zambesi) and joined the two northern points of Mr. Simm's work which had been completed in 1901. The work was delayed by famine and periodic haze, both of which are of common occurrence in Africa. The native heliographists had to be trained to direct the rays of light with accuracy and certainty before any observing could be done.

The sides of triangles average 45 miles in length, the longest being 80 miles. There are 35 principal stations, and the figures are generally quadrilaterals. The maximum triangular error was ± 2·9 seconds, while the mean error of an observed angle will be about ± 0·4″ seconds.

Only one base was measured; time did not permit of measuring a second as had been originally intended. This base was measured twice with a discrepancy of about 0·04 metres between the two measurements of its (17,401 metre) length. The measurements were made with Jaederin Invar wires standardised during the work with a comparator 2½ metres long generously lent by the Russian Government.

The latitude at 22 stations was observed by Talcott's method, and observations for azimuth were made at two places. The remainder of the work includes 30 secondary stations and about 1,000 topographic points, chiefly hill tops, many of which had tops sharp enough to permit them to be regarded as of almost secondary accuracy. Such topographic points were fixed by observations from not less than three main stations.

Some plane table and compass work was carried out as time and opportunity offered. Some points on the Anglo-Portuguese boundary at the 15th parallel south, on the Loangwa River, were fixed astronomically and connected with the geodetic chain.

The farm surveys in North-Eastern Rhodesia are carried out by surveyors, nominated by the administrator, by trigonometric methods. Surveys of large properties by chain, stadiometer, tacheometer, or compass are not permitted to be used for the issue of the final title.

(iii.) North-Western Rhodesia.

An area of 15 miles round the Victoria Falls has been surveyed, and in addition a few farms.

The geographical position of Kalomo, the administrative headquarters of the territory, has been fixed.

District Commissioners when travelling make road sketches, and these have been compiled and a map of North-Western Rhodesia published.

(iv.) Existing Maps.

1. Farm maps of Matebele and Mashonaland, four sheets each, *compiled* by the Surveyor-General's Department, Southern Rhodesia. Scale 5 miles to 1 inch.

   Rivers, farm beacons, and boundaries, with their names, are shewn on each sheet.

2. A six-sheet map of Rhodesia. 16 miles to 1 inch. Sold by Ed. Stanford, Long Acre, W.C.

   The compilation is an old one, but it has been corrected from time to time as new material became available.

3. Map of North-Eastern Rhodesia. *Just published.*
4. Boundary Commission maps.

SIERRA LEONE.

Governor ... ... Leslie Probyn, Esq., C.M.G.
General Officer Commanding... Major-General J. K. Trotter, C.B., C.M.G.

There is no survey department.

In 1904 the Colonial Survey Section under Captain H. D. Pearson, R.E., surveyed the neighbourhood of Freetown on the scale of one inch to one mile. This map embraces an area of 250 square miles; it is printed in four colours and is on sale. There is a general map of the Colony on the scale of $\frac{1}{1000000}$, compiled by the Topographical Section of the General Staff, from Boundary Commission maps and explorations. (T.S.G.S. 2,082).

There are also the regular sheets of the $\frac{1}{1000000}$ series (58, 59, 70, 71).

There are the recently revised sheets of the $\frac{1}{250000}$ series compiled from all available sources but not based on regular surveys (58 K, 58 O, 70 D, 59 I, 59 M, 71 A).

The frontiers between Sierra Leone and French territory, and Sierra Leone and Liberia have been completely demarcated, and maps of these frontiers are available.

In the present state of development of the Colony it is not considered necessary to spend money on a regular survey. The General Officer Commanding is carrying out a military survey of that portion of the Colony adjacent to the area already surveyed.

SOUTH AFRICA. (GENERAL CONDITION OF THE SURVEYS.)

(i.) *The Survey Departments.*
(ii.) *The Geodetic Triangulation.*
(iii.) *Imperial Requirements.*
(iv.) *The Survey Congress of 1904.*
(v.) *General State of the Maps.*
(vi.) *"Compilation" Maps.*

(i.) The Survey Departments.

The Colonial Survey Committee is not concerned with the surveys of the South African Colonies, except in so far as Imperial interests are involved. The Cape Colony, Natal, the Transvaal, and the Orange River Colony, have each a Survey Department, administered by a Surveyor-General. These Survey Departments are, in effect, land record departments. The farms are surveyed by licensed surveyors, and plans and records of the farms are kept in the Surveyor-General's Office. For purposes of land registration the system is an efficient one. The farm plans as a rule show only what is necessary for the definition of the property boundaries; each farm is surveyed independently. From the nature of the case little or no attention is paid to the delineation of the hill features.

(ii.) The Geodetic Triangulation.

South Africa is covered with a geodetic triangulation of the first order. This triangulation was commenced in 1883. The Cape Colony and Natal were completed in 1892.

The triangulation of the Transvaal and Orange River Colony was commenced in 1903, the field work is now complete, and the computations of this part of the work will shortly be published. In Rhodesia a chain of triangles extends along the meridian 30° E. to a point 60 miles south of Kituta at the south end of Lake Tanganyika. The gap in this chain between the River Limpopo and Gwelo was completed during the past year by Captain H. W. Gordon, R.E.

The conception and organisation of this work are entirely due to Sir David Gill, K.C.B., F.R.S., and the execution and superintendence of it has been throughout in the hands of Colonel Sir William Morris, K.C.M.G., C.B.

The geodetic triangulation has cost about £180,000; not one penny of this has come from the pockets of the British taxpayer at home. The colonies of South Africa are to be congratulated upon the foresight which prompted, and the ability and energy which rendered possible, the execution of this great framework, which ensures the accuracy of all future South African surveys, and which will eventually many times repay its cost.

(iii.) Imperial Requirements.

The chief Imperial requirement is the provision of maps for the defence of the colonies. This matter has not been directly before the Colonial Survey Committee, and the information which follows has been furnished by the War Office.

(iv.) The Survey Congress of 1904.

In February and March, 1904, a conference was held at Cape Town composed of Sir David Gill, President, a representative of the War Office, and the Surveyors-General of all the colonies of South Africa, including Rhodesia.

The object of the conference was the formulation of a scheme for the systematic topographical survey of the whole of South Africa.

A unanimous report was drawn up, but in the light of subsequent events it appears that the conference opened its mouth too wide. Some of the colonial governments found that the financial situation did not enable them to contribute the money required, and in May, 1905, the High Commissioner reported to the Secretary of State for the Colonies that the scheme must be regarded as indefinitely postponed.

Although the general scheme failed, the necessity of mapping South Africa has not been lost sight of. The general situation is as follows.

(v.) General State of the Topographical Maps of South Africa.

The production of topographical maps is proceeding in the Cape Colony and in the Orange River Colony (*see* pp. 44 and 46). The question of a topographical map of Natal is under discussion. A sketch of Basutoland is being carried out. Practically no topographical maps exist of the Transvaal, and no such maps are being produced.

A little topographical work has been carried out in Northern Rhodesia during the execution of the geodetic triangulation.

(vi.) Compilation Maps.

"Compilation" maps are those fitted together from farm surveys. Of this nature are the Cape Colony district maps and the following maps made during the war by the Field Intelligence Division:—the 4-mile "Imperial" map, initiated by Major Davies and Captain Kirkpatrick and produced by Messrs. Wood and Oertlepp, and the "Degree Sheets" of the Orange River Colony and the Transvaal on the scale of 2·37 miles to 1 inch, produced under the superintendence of Colonel H. M. Jackson, A.A.G. for Topography. These compilations serve to give the farm names, but are misleading as regards the hill features.

THE CAPE COLONY.

(i.) *Organization of the Reconnaissance Survey.*
(ii.) *List of Seconded Officers.*
(iii.) *Accuracy of the Work.*
(iv.) *Progress of the Work.*

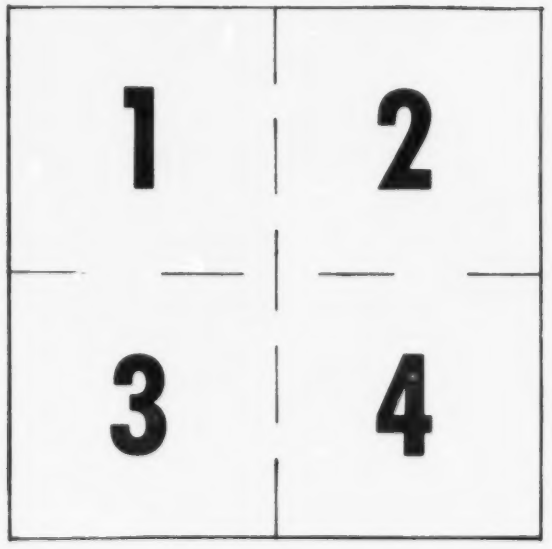
(i.) Organization.

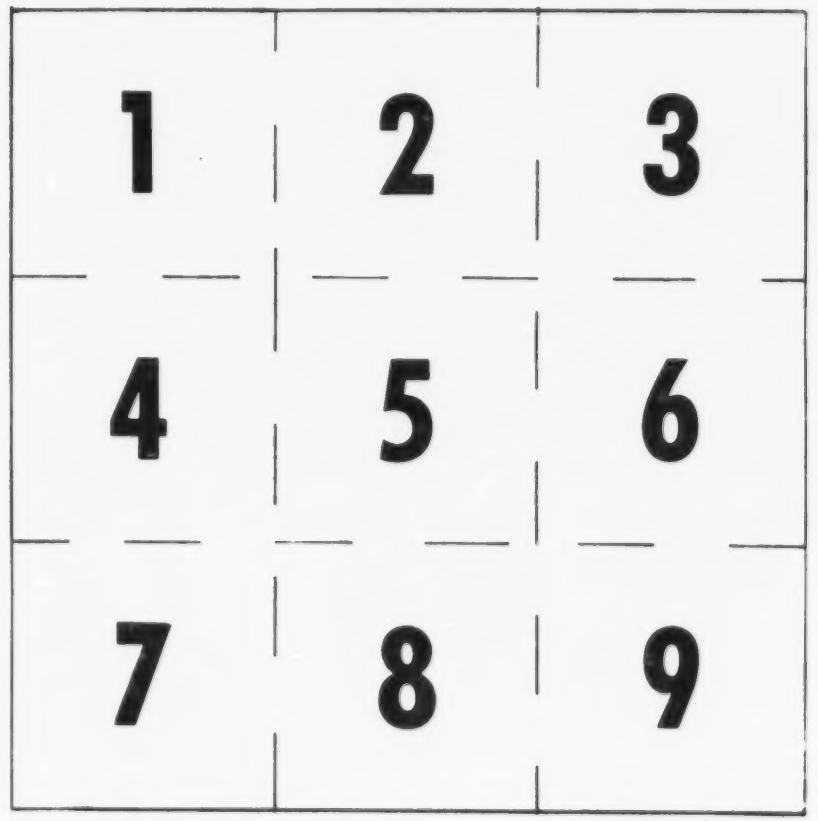
A reconnaissance survey is being carried out in the Cape Colony. Six officers, seconded from regimental duty, and seven other officers who are detached for the purpose from their regiments (except during the training season), are employed on this duty. Captain C. G. W. Hunter, R.E., is in charge.

The surveys are carried out by plane-tabling. Fixed points for the plane-tables are provided as follows:—The work is based on the chains of the geodetic triangulation. Between these chains minor instrumental chains are run, and the positions of the minor stations are computed and plotted. The area under survey is now covered with a network of graphic triangulation.

CAPE COLONY.—RECONNAISSANCE SURVEY CAIRN

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





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SOUTH AFRICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

Miles 50 0 50 100 150 200 Miles

REFERENCE

Work in progress

Field sheets completed

Sheets published

Red names show names of sheets

The sheets on the scale of $\frac{1}{125,000}$ are numbered thus 129-B III

GERMAN SOUTH WEST AFRICA

BECHUANALAND

ORANGE RIVER COLONY

TRANSVAAL

BASUTOLAND

NATAL

16° 17° 18° 19° 20° 21° 22° 23° 24° 25° 26° 27° 28° 29° 30°

22° 23° 24° 25° 26° 27° 28° 29°

Tuli
RHODES' DRIFT
ZOUTPANSB
121-R
122-M
R. Lotsani
Palapye
121-Q
MAGALAKWIN
Sand R.
Louis Trichard
R. Letaba R.
N. PONGOLA FLATS
121-V
121-W
BLAAUWBERG
121-X
122-S
R. Limpopo
R. Motwani
R. Pongola
R. Magalakwin
PIETERSBURG
Marabastad
LEYDSDO
Mochudi
Gaberones
125-C
DERDEPOORT
125-D
KRANTZBERG
125-E
PYLSTROOM
125-F
GELUK
126-A
OHRIGSTA
R. Crocodile
R. Marico
R. Elands
Pienaars
Lydenburg
125-H
125-J
125-K
125-L
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MAFEKING
RUSTENBURG
PRETORIA
MACHADODORP
Belfast
Lichtenburg
Krugersdorp
Carolina
MARIBOGO
125-N
Geysdorp
125-O
125-P
125-Q
125-R
Bethal
Ermelo
126-M
AMSTERDAM
Vereeniging
Vryburg
KLERKSDORP
POTCHEFSTROOM
R. Vaal
R. Harts
Wolmaransstad
BOTHAVILLE
FRANKFORT
Heilbron
Volkrust
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KROONSTAD
Lindley
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Hoopstad
R. Zand
Ventersburg
Newcastle
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Warrenton
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Weenen
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GRIQUATOWN
KIMBERLEY
N. Modder
R. Vet
R. Nett
Jacobsdal
Orange R.
Brakfontein
128-L
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129-J
Maseru
Weston
DeWetsdorp
GRANT'S CASTLE
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ORANGE RIVER MOUTH
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127-E
127-F
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MOLOPO
128-C
UPINGTON
128-D
128-E
R. Molopo
R. Kakamas
KHEIS
Pella
R. Hartebeest
KENHART
Diep Fontein
Irrachoender
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to the sheets of

RICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

0 50 100 150 200 Miles

REFERENCE

Work in progress

Field sheets completed

Sheets published

Red names shew names of sheets

The sheets on the scale of 1/125000 are numbered thus 129-B-III

TRANSVAAL

ORANGE RIVER COLONY

BECHUANALAND

SOUTH WEST AFRICA

BASUTOLAND

SWAZILAND

ZULULAND

NATAL

PORTUGUESE EAST AFRICA

Tuli
RHODES DRIFT
ZOUTPANSBERG 122-M
PAFURI 122-N
122-O
Palapye
MAGALAKWYN 121-Q
121-R
Louis Trichard
N. PONGOLA FLATS 121-V
121-W BLAAUWBERG
121-X
122-S
LETABA 122-T
122-U
PIETERSBURG
LEYDSDORP
Marabastad
Mochudi
125-C DERDEPOORT
125-D KRANTZBERG
125-E
125-F WYLSTROOM
125-T
126-A GELUK
OHRIGSTAD
UMBABAT 126-B
126-C
Lydenburg
Pienaars
125-H
125-J
125-K
125-L
126-G
KOMATI POORT 126-H
126-I
ZEERUST
RUSTENBURG
PRETORIA
MIDDELBURG
MACHADODORP
Belfast
Barberton
Lourenço Marques
MAFEKING
Lichtenburg
Krugersdorp
MARIBOGO 125-N
Geysdorp
125-O
125-P
HEIDELBERG 125-Q
125-R
Bethal
Ermelo
126-M AMSTERDAM
126-N
BREMERSDORP
126-O
Carolina
Vryburg
KLERKSDORP
POTCHEFSTROOM
Vereeniging
ANDERTON
Piet Retief
Wolmaransstad
BOTHAVILLE
125-U
125-V KROONSTAD
Heilbron
FRANKFORT
125-W
VREDE 125-X
Volkrust
Wakkerstroom
Taungs
125-T BLOEMHOF
Hoopstad
Lindley
126-S UTRECHT
126-T
126-U
Newcastle
Vryheid
Warrenton
Ventersburg
BETHLEHEM
HARRISMITH
Dundee
NDWANDWE
WARMBAD 128-A
STOLZENFELS 128-B
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UPINGTON 128-D
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Poaphuil
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129-E
Ladysmith
130-B
130-C
Campbell
KHEIS
GRIQUATOWN
KIMBERLEY
BRANDFORT
Ficksburg
Thlotse
Colenso
Weenen
Kakamas
Pella
KENHART
Jacobsdal
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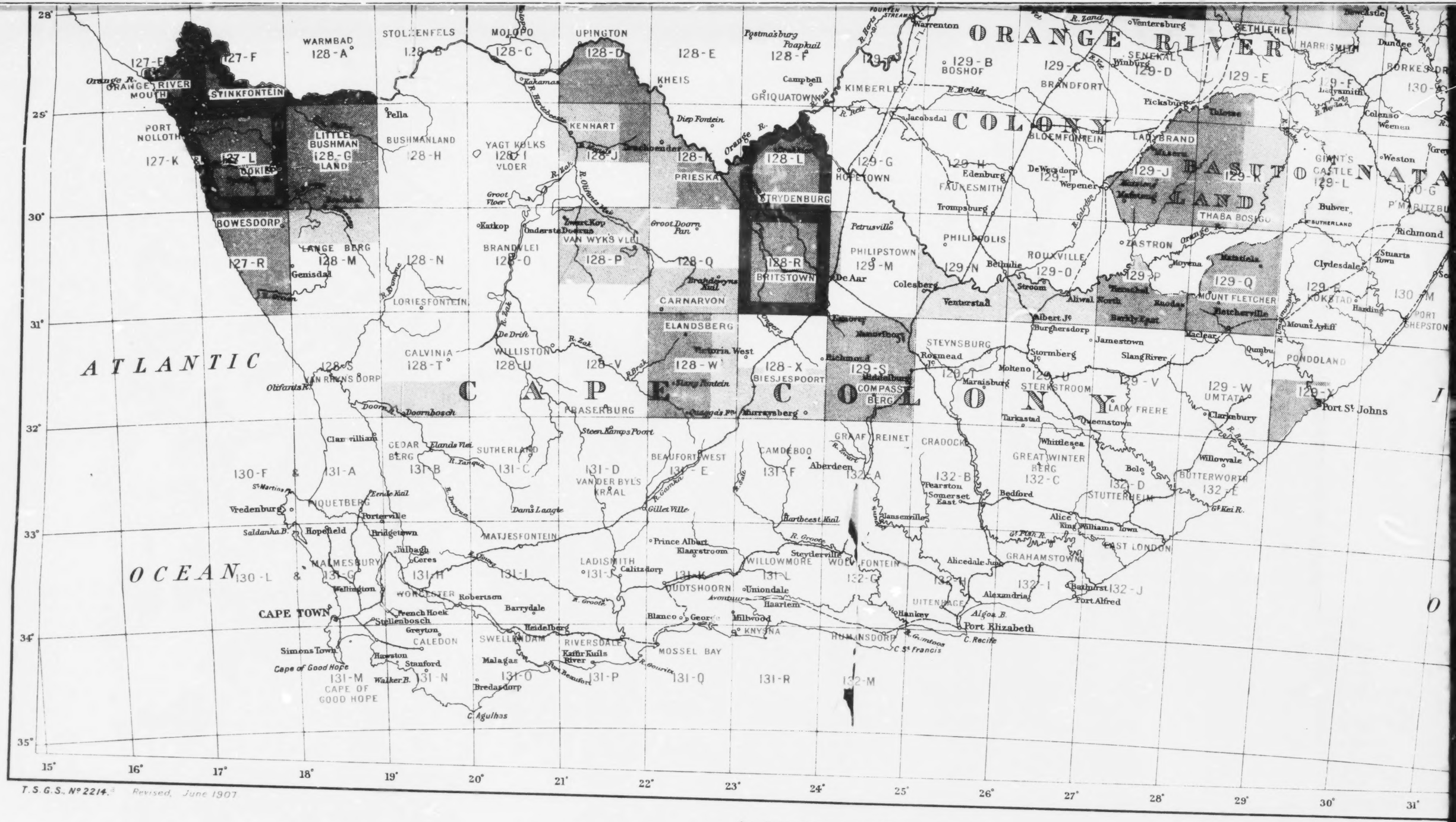
LADYBRAND
Maseru
Greytown
Weston
LITTLE BUSHMAN 128-G
BUSHMANLAND 28-H
YAGT KOLKS 128-I
128-J
128-K
128-L
129-G
129-H
129-J
De Wetsdorp
GIANT'S CASTLE
126-L
STANGER


ATLANTIC OCEAN
CAPE COLONY
ORANGE RIVER COLONY
BASUTOLAND
NATAL
PONDOLAND
STINKFONTEIN
LITTLE BUSHMAN LAND
BOWESDORP
BOKKEVELD
PORT NOLLOTH
ORANGE RIVER MOUTH
WARMBAD
STOLTZENFELS
MOLOPO
UPINGTON
KHEIS
KENHART
PRIESKA
STRYDENBURG
BRITSTOWN
CARNARVON
ELANDSBERG
VAN WYKS VLEI
BRANDVLEI
LORIESFONTEIN
CALVINIA
WILLISTON
VAN RHYNS DORP
CLANWILLIAM
CEDARBERG
SUTHERLAND
TULBAGH
CERES
WORCESTER
ROBERTSON
CAPE TOWN
STELLENBOSCH
SIMONS TOWN
CAPE OF GOOD HOPE
CALEDON
SWELLENDAM
RIVERSDALE
HEIDELBERG
MOSSEL BAY
GEORGE
KNYSNA
PLETTENBERG BAY
BREDASDORP
C. AGULHAS
VANDERBYLS KRAAL
LADISMITH
CALITZDORP
OUDTSHOORN
BARRYDALE
HOPEFIELD
SALDANHA B.
VREDENBURG
PORTERVILLE
PIQUETBERG
MALMESBURY
BEAUFORT WEST
PRINCE ALBERT
GRAAFF REINET
CAMDEBOO
ABERDEEN
MURRAYSBURG
RICHMOND
COLESBERG
DE AAR
PHILIPSTOWN
HOPETOWN
GRIQUATOWN
CAMPBELL
KIMBERLEY
BOSHOF
WARRENTON
POSTMASBURG
PAAPKUIL
DIEP FONTEIN
KAKAMAS
PELLA
BUSHMANLAND
YAGT KOLKS VLOER
GROOT VLOER
KATKOP
ONDERSTE DOORNS
ZWART KOP
GROOT DOORN PAN
BRANDYBOYS KUIL
LANGE BERG
GENISDAL
TRIGONOMETRICAL BEACON
FOURTEEN STREAMS
R. VAAL
VENTERSBURG
BETHLEHEM
HARRISMITH
SENEKAL
BINBURG
BRANDFORT
FICKSBURG
THEUNS
LADYBRAND
JACOBSDAL
EDENBURG
FAURESMITH
TROMPSBURG
DEWAGDORP
WEPENER
BLOEMFONTEIN
PETRUSVILLE
PHILIPPOLIS
BETHULIE
ROUXVILLE
ZASTRON
MOYENA
MATATIELE
MOUNT FLETCHER
FLETCHERVILLE
GIANT'S CASTLE
WESTON
BULWER
RICHMOND
CLYDESDALE
STUARTS TOWN
KOKSTAD
HARDING
PORT SHEPSTONE
MOUNT AYLIFF
MACLEAR
UMTATA
CLARKEBURY
PORT ST JOHNS
LADY FRERE
QUEENSTOWN
TARKASTAD
STERKSTROOM
MARAISBURG
ROSMEAD
STEYNSBURG
BURGHERSDORP
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VENTERSTAD
ALBERT JC
JAMESTOWN
STORMBERG JC
SLANG RIVER
MOLTENO
COMPASSBERG
RICHMOND
MIDDELBURG
NORVAL'S POORT
BIESJESPOORT
MURRAYSBURG
GILLETTVILLE
DAM'S LAAGTE
STEEN KAMPS POORT
DOORNBOSCH
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ZAK R.
DE DRIFT
BRAK R.
DOORN R.
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KLEIN VISCH R.
GREAT FISH R.
GREAT KEI R.
KING WILLIAMS TOWN
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CRADOCK
WHITTLESEA
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WILLOWVALE
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STUTTERHEIM
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PORT ALFRED
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PORT ELIZABETH
C. RECIFE
C. ST FRANCIS
HANKEY
MILLWOOD
HAARLEM
UNIONDALE
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R. GOURITZ
R. GROOTE
R. GOUNE
R. DOORNE
R. DANIELS
R. TANQUA
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R. GOUNAS
R. TANQUA
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R. BRAK
R. DOORN
R. OLIFANTS
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R. HARTBEESTE
R. OLIFANTS WES
R. ZAK
R. BONNIES
R. KLEIN VISCH
R. ORANGE
R. MODDER
R. RIET
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R. ZAND
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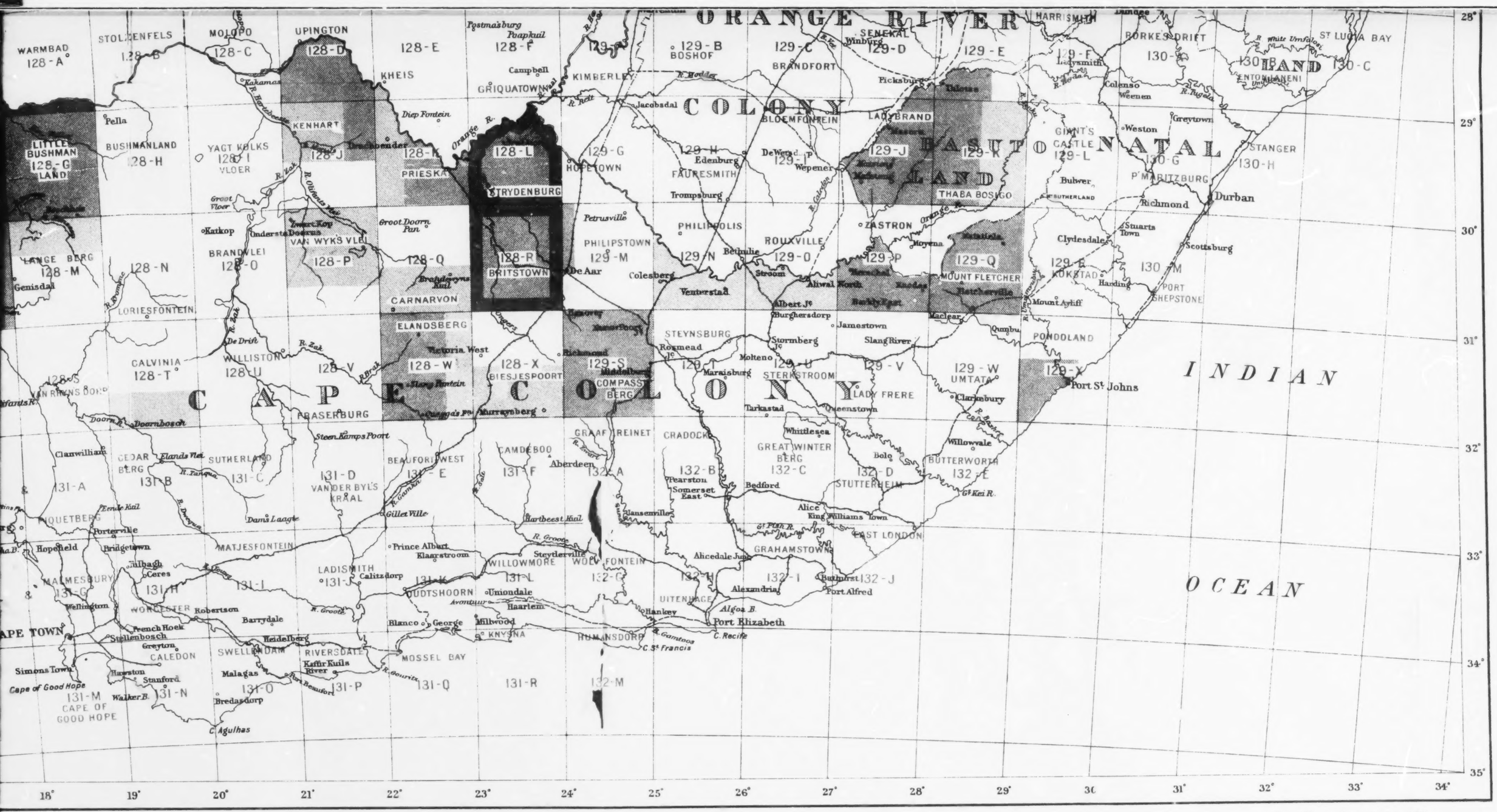
R. KAREE
R. ORANG



War Office. Revised July 1907.

Compiled in the Topographical Section, General Staff.

1906

AGENTS FOR THE SALE OF MAPS PUBLISHED BY THE TOPOGRAPHICAL SECTION, GENERAL STAFF.

LONDON	EDWARD STANFORD.	MANCHESTER	J. E. CORNISH.
EDINBURGH	JOHN MENZIES & Co.	GLASGOW	JOHN MENZIES & Co.
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and the points of the graphic triangulation are sufficient in number and accuracy to control the plane-tabling. The method is, in fact, generally similar to that employed by the Topographical Branch of the U.S. Geological Survey in the West of the United States. The work shows a continuous improvement. During the first year, owing to want of system and method, a good deal of reconnaissance survey was carried out which it has since been necessary to reject.

The officers work in parties of two. Each party is provided with riding horses, 1 wagon with 8 mules, 1 Scotch or Cape cart with 4 mules, and 3 natives. In Prieska and Carnarvon Districts the wagon mules are replaced by 14 donkeys. In Namaqualand the wagon is drawn by 12 oxen.

The office staff at Cape Town consists (in addition to the officer in charge) of 1 officer, 2 draughtsmen, and 2 clerks.

(ii.) The Seconded Officers.

The officers seconded for reconnaissance work in the Cape Colony are :—

Captain H. S. P. Simon, D.C.L.I.
„ C. W. Gordon, North. Fusileers.
„ A. B. Johnson, Linc. R.
„ R. B. Hopkins, Manch. R.
„ T. S. N. Hardinge, R.A.
Lieut. R. A. Reddie, 16th Lancers.

(iii.) Accuracy of the Work.

Two chains of rapid triangulation were carried out in 1906-07 connecting the geodetic triangulation along the 31st parallel with that north of the Orange River near Upington. One chain was 70 miles long, and the other 130 miles. In each case the closing error was about 1 second of arc (thirty-three yards).

(iv.) Progress of the Work.

The area completed in the field between March, 1903, and March, 1906, was 24,000 square miles.

During the year ending March 31st, 1907, 17,000 miles have been completed, making the total area surveyed 41,000 square miles. On an average, allowing for leave and accidents, ten officers have been employed on the reconnaissance during the past year.

Six sheets have been published on a scale of $\frac{1}{250000}$.

Captain Hunter and the other officers employed on this duty have done excellent work during the past year, and the results are very satisfactory.

THE ORANGE RIVER COLONY.

(i.) *Origin of the Topographical Survey.*
(ii.) *Methods.*
(iii.) *Progress and Accuracy.*
(iv.) *Organization.*
(v.) *Character of Country.*
(vi.) *Financial.*
(vii.) *The Value of Co-operation.*

(i.) Origin of the Topographical Survey.

The Topographical Survey of the Orange River Colony, which is being carried out by the Colonial Survey Section, is the result of an arrangement between the War Office and the Colonial Government.

In September, 1905, the Section, consisting of two officers and four non-commissioned officers, left England. The officer commanding the Section is Captain L. C. Jackson, R.E. Work was commenced in October in the neighbourhood of Kroonstad and is being systematically prosecuted sheet by sheet. It is anticipated that the survey of the whole Colony, which has an area of about 47,000 square miles, will be completed in 5½ years, and that by about the summer of 1911 all the sheets will have been published.

(ii.) Methods.

The survey is based upon the geodetic triangulation. This is being broken up into a secondary triangulation, of which the sides average about 10 miles.

The secondary points are plotted on plane-tables and the detail survey is carried out entirely by rigorous plane-tabling. All the heights depend on the geodetic values.

(iii.) Progress and Accuracy.

Up to the 1st June, 1907, a total area of 12,148 square miles has been surveyed in detail in the field. Triangulation has been completed over a total area of 13,150 square miles.

During the past year the average daily output has been 22·62 square miles per diem. The total number of points fixed trigonometrically is 297 ; of these 111 have been permanently marked.

The mean triangular error during the past year was 2·9″.

The greatest linear errors of displacement, as tested by the geodetic triangulation at the extremity of a chain 45 miles long, were 3 feet in latitude and 2 feet in longitude.

The probable error of a trigonometrical height, as tested by the geodetic values, is under 1 foot.

Four sheets of the military edition of the $\frac{1}{126000}$ map have been published during the year. The civil edition, which shows farm boundaries, will follow later.

The incidence of the published sheets can be seen by inspection of the index diagram.

The work of the Colonial Survey Section is of an exceedingly satisfactory nature, both as regards progress and accuracy, and reflects great credit on Captain Jackson and those serving under him.

(iv.) Organization.

The strength of the Colonial Survey Section is 2 officers, 4 non-commissioned officers, and 13 permanently engaged natives.

The transport consists of 8 horses, 26 mules, 1 wagon, 3 Scotch carts, and 4 Cape carts.

The section is divided into two sub-sections of one officer and two non-commissioned officers, each with half the transport. Each officer undertakes the execution of the triangulation for his sub-section and the general supervision of the field work. The non-commissioned officers are entirely employed on plane-tabling. Each non-commissioned officer surveys a complete block of country 15 minutes square; four such field sheets are always in hand, and each sheet takes about six weeks to complete. Camps are so selected that the plane-tables are about equally distant from the centres of their respective sheets.

(v.) Character of the Country.

To the west of Kroonstad the country surveyed included the Sand Veld. Its general altitude is about 4,000 feet above mean sea level. It is a sandy, flat, uninteresting district with few prominent features. In the dry season water is scarce.

Going eastwards through Kroonstad the country changes to open, rolling, grass veld. It rises gradually, and the features become more and more well defined until the Drakensberg range is reached on the Natal border. The boundary follows the watershed at an average altitude of about 6,500 feet, rising to 7,400 at the "Neutral Beacon," where the three colonies, Natal, the Transvaal, and the Orange River Colony, meet. On the east the Drakensberg is very steep and in some places precipitous, with a fall of 2,000 or 3,000 feet into the plains of Natal. South of Vrede and along the border towards Harrismith the country is much intersected by steep kloofs and is very difficult. Roads are few and rough, and in many places it is impossible to get about even on horseback. At the close of the wet season the high ground is often enveloped in clouds for two or three

days at a time. Fog and mist not only cover the high peaks, but descend into the valleys and plains. Fortunately horse sickness is rare in the high districts.

(vi.) Financial.

The estimated annual cost of the survey is £3,369, and the total cost £18,500; of this the Orange River Colony has contributed £9,000, and the rest is charged to Army votes.

(vii.) The Value of Co-operation.

Last year the Surveyor-General and the officer commanding the Colonial Survey Section discussed the question of the information required for civil purposes, and came to an agreement on the subject. Throughout the negotiations the Government of the Colony met the War Office in a very friendly spirit.

Like the other South African Colonies, the Orange River Colony is possessed of a first-class geodetic triangulation and has an efficient system of farm survey and land registration. If to these is added the excellent topographical survey above described, it will be seen that the position of this Colony is, in respect of surveys, superior to that of any other British Colony or Protectorate in Africa.

SOUTHERN NIGERIA.

Governor ... ... Sir Walter Egerton, K.C.M.G.

Director of Surveys ... ... Mr. E. P. Cotton.

(i.) *Historical Sketch.*
(ii.) *Present Staff.*
(iii.) *Work carried out during* 1906–07.
(iv.) *Present State of the Maps.*
(v.) *Cost of the Department.*

(i.) Historical Sketch.

(a) *Lagos (now Western Province of Southern Nigeria).*

Between January 1901 and January 1906, the constitution and functions of the Survey Department remained much the same. But in the earlier years many of the staff had little professional knowledge, and it devolved upon the Commissioner of Lands, Mr. E. P. Cotton, to train the personnel.

During these years also much time was devoted to the carrying out of accurate theodolite traverses; up to December, 1904, 800 linear miles of such traverses had been completed.

In 1904 the longitude of the transit instrument of the observatory at Lagos was determined by exchange of telegraphic signals with the Royal Observatory at the Cape of Good Hope.

In 1905 the boundary of the Egba territory was surveyed and marked. In 1905 and 1906 780 miles of fresh traverse work was carried out.

Not much cadastral work has been required, but from time to time miscellaneous plans have been produced.

(b) *Southern Nigeria (now Eastern Province).*

A small Survey Department was formed in March, 1901, consisting of two R.E. officers, one native surveyor, and one clerk. The Superintendent of Surveys, up to the date of amalgamation of the department with that of Lagos, was Captain A. J. Woodroffe, R.E. From April to June, 1901, the party was employed on the survey of a route for a telegraph line from Bonny to Calabar. From November, 1901, to May, 1902, the party was similarly employed between Ogbo and Forcados. During the latter part of the same period the officers were employed in a military capacity with the Aro Field Force, and in fixing the boundary between Northern and Southern Nigeria.

From November 1902 to January 1903, geographical positions were fixed on the Kwa River.

From January 1903 to May 1903, the party erected the telegraph line from Ogbo to Forcados, and from November 1903 to May 1904, the party was similarly employed between Bonny and Calabar.

From November 1904 to June 1905, positions were fixed on the Cross River, the Oban Hills were triangulated, and compass traverses were made of the country to the north of Abokam.

From November 1905 to August 1906, the party was employed upon the Anglo-German (Southern Nigeria-Cameroon) Boundary.

It will be seen that the work carried out was of a very miscellaneous character. Some good geographical work was done, notably the triangulation of the Oban region, but the custom of detaching the party for non-geographical duties, convenient as it was at the time, had the serious drawback that the execution of anything like a systematic scheme became impossible. In fact, no systematic progress was made, and the mapping of the Eastern Province has yet to be seriously undertaken. Piecemeal, irregular work is expensive in the long run, and should not be permitted in the future.

In the autumn of 1906 Captain Woodroffe completed his tour of service in Southern Nigeria, and the two departments were amalgamated under Mr. E. P. Cotton as Director of Surveys.

(ii.) Present Staff.

The Department consists of :—

The Director of Surveys.
6 European surveyors.
6 Native surveyors and draughtsmen.
4 Native students.

(iii.) Work carried out during 1906-07.

Theodolite Traverses	...	...	200 linear miles.
Compass „	...	...	3,000 „ „

100 determinations were made of latitude and azimuth, and 20 of telegraphic differences of longitude.

The area under survey is shown on the attached diagram. It is anticipated that Sheet 73 E will be completed by September 1907.

A serious defect in the mapping of the area indicated is that the Director of Surveys has taken no steps to effect the delineation of the relief or hill-features, whether by barometer determinations or by other recognised methods.

Although a Survey Department has existed for about 6 years, and although liberal funds have been allotted for the purpose of mapping this Colony, up to the present time (June 1907), no material fit to form a final map has been received by the Colonial Office. Much time appears to have been spent in the execution of traverses, many of which are of an unnecessary degree of precision; some of the methods adopted appear to show a want of a sense of proportion, and of appreciation of the truism that the Department exists not to make traverses but to make maps. No degree of technical excellence in details compensates for the fact that the main object in view has not so far been attained.

(iv.) Present State of the Maps.

Maps available :—

Southern Nigeria and Lagos, scale $\frac{1}{1000000}$, one sheet, T.S.G.S., also in two sheets.

Southern Nigeria, scale $\frac{1}{500000}$, one sheet.

Southern Nigeria-Cameroon boundary zone, scale $\frac{1}{100000}$.

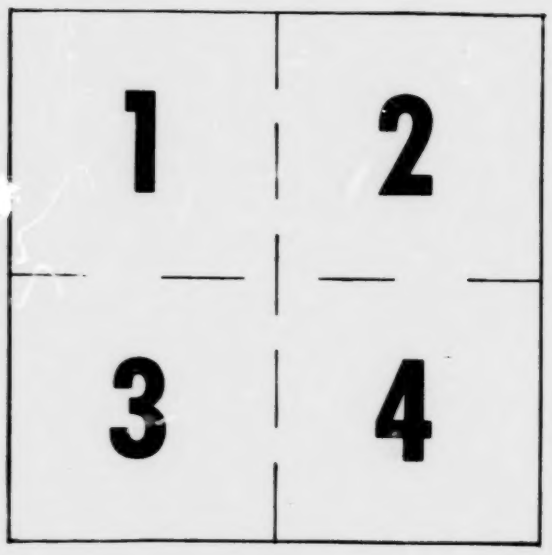
Lagos and Southern Nigeria, $\frac{1}{250000}$, 19 sheets, T.S.G.S.

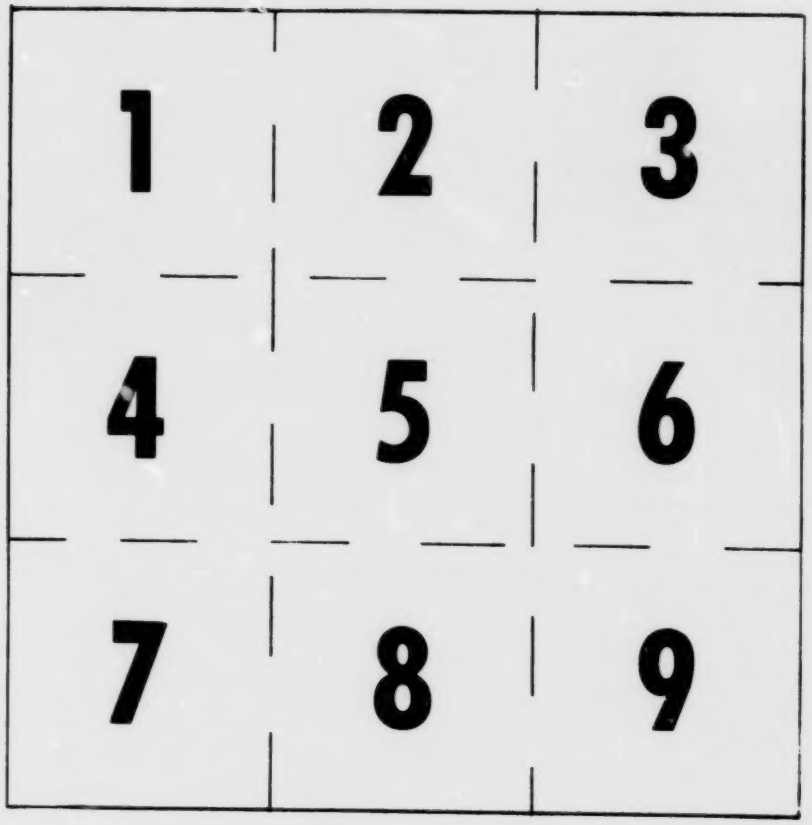
All the above maps are compiled from sketches, and will be eventually superseded.

(v.) Cost of the Department.

The estimated expenditure of the Survey Department for 1907 is £7,593, and of the Land Office £1,253.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





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Egoa Ilaro Shagomo Ijabu Ode Ondo R. Ona R. Ose Efan

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Bodi Kishi Jebba Bida

Ogborro Igbete

R. Niger

Egbom

Ilorin

R. Ogun

Ogbomosha

Oyo

Aiedia

Lokoja

R. Benue

Ede Oshogbo

Iwo Ilesa Ikeji

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T.S.G.S. Nº 2221 b

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War Office, Sept 1906
Revised, July 1907

UGANDA.

Commissioner ... ... Mr. HESKETH BELL, C.M.G.
Director of Surveys ... ... Mr. R. C. ALLEN.
Deputy Director of Surveys ... Mr. W. V. MORRIS.

(i.) *Duties of the Survey Department.*
(ii.) *Staff of the Department.*
(iii.) *Inspection.*
(iv.) *Employment of Natives.*
(v.) *Present State of the Surveys.*
(vi.) *Present State of the Maps.*
(vii.) *Financial.*

(i.) DUTIES OF THE SURVEY DEPARTMENT.

The Survey Department of Uganda is entrusted with the execution of the following duties:—

The production of a Topographical Map for administrative purposes on the scale of $\frac{1}{126000}$, and the production of cadastral plans of the "Kingdom of Uganda" on the scale of $\frac{1}{10000}$.

The latter are required for the allotment of estates to chiefs and landowners in accordance with the Uganda Agreement of 1900. These estates, aggregating some 9,100 square miles, are scattered about all over the kingdom, and until they are demarcated and the areas to which each chief and landowner is entitled are definitely settled, it is not possible to know which lands are Crown lands and which the property of the natives. It is also necessary to define the Crown forests of the Protectorate.

The Survey Department was put on a proper footing in order to allay the feeling of unrest throughout the country on the subject of land. Each landowner has in the meanwhile been given a preliminary certificate admitting his claim, subject to rectification by the survey.

The Commissioner of Uganda reports that he looks upon "this mapping of the estates and the eventual settlement of the land question as the main factor in the peace and development of the country."

The Chief Surveyor of Uganda estimates that the area which it is necessary to survey on the $\frac{1}{10000}$ scale is 15,150 square miles.

(ii.) Staff of the Department.

The present authorized strength of the Survey Department is :—

Director of Surveys.
Deputy Director of Surveys.
Assistant Director of Surveys.
4 Senior surveyors.
10 Junior surveyors.
1 Indian surveyor.
4 Indian clerks and draughtsmen.

(iii.) Inspection of the Department.

For the reasons set forth on p. 28 Major Hills, C.M.G., was deputed to inspect various Survey Departments, and amongst them that of Uganda. The inspection took place in March, 1907. Major Hills reported that the size of the department was sufficient for the work in hand, and did not advise any material increase in expenditure on surveys. He made several important recommendations, viz. : that the work in the field should be carried out by properly organized parties, that the Director should more frequently inspect the work in the field, that the field parties should be allowed within limits a free hand, that an annual recess season of three months should be established, to be spent by the field parties at Entebbe, during which time fair plotting and calculating should be carried out, and that on no account should members of the staff of the Survey Department be employed upon other than their proper departmental work.

Major Hills reported that it was not possible to expedite materially the progress of the cadastral work. He anticipates an output of 600 square miles per annum, and at this rate of progress the completion of the cadastral survey of the kingdom of Uganda will take 25 years.

He estimates the annual out-turn of topographical work on the $\frac{1}{125000}$ scale as 1,500 square miles per annum. The area of Uganda proper is 16,300 square miles, of which 3,084 square miles have been surveyed. The topographical survey will therefore probably be completed in about nine years.

(iv.) Employment of Natives.

Major Hills reports as follows :—

"The conditions in Uganda are different from those obtaining in East Africa. The Baganda, being of a much higher class of intellectual capacity than any of the other neighbouring tribes, are probably capable of receiving a fair technical education.

There is considerable probability that, in the future, men will be obtainable in the country competent to become valuable members of the survey staff. Already some of the natives employed have been trained as chainmen, a duty for which they are fully fitted, but such men belong only to the lower classes of the population, and their capacity is little or no guide to the degree of competence which may be fairly expected from educated natives of the upper class. The High School at Kampala is now training selected boys, sons of chiefs, &c., and an early opportunity should be taken of obtaining two or three such youths, on the completion of their school course, and training them in survey work. The rate of pay expected would be about Rs. 30 to Rs. 35 per month during apprenticeship, afterwards rising by steps to a maximum, not, however, to be reached for several years, of Rs. 100 per month. This is equal to £80 per annum, and as such men would travel much more cheaply than Europeans, would require fewer porters, could live largely on the native food, and, finally, would not suffer from the climate, nor require long periods of leave, the total saving compared with European surveyors at £300 per annum would be very large."

(v.) Present State of the Surveys.

A total area of 3,084 square miles has been topographically surveyed (up to 30th April, 1907), 3 sheets are ready for publication with the exception of the southern portion of the sheet abutting on the lake; this was left uncompleted owing to the sleeping sickness. The total area of main triangulation completed is 7,622 square miles. The mean triangular error is 4″·9.

A total area of about 408 square miles has been cadastrally surveyed.

(vi.) Existing State of Maps.

The following maps exist :—

$\frac{1}{1000000}$, 1 sheet (No. 86), T.S.G.S. (Sheet 93 is in preparation.)

$\frac{1}{2500000}$, 16 sheets, provisional, T.S.G.S. These are based on sketches and will be superseded by the results of the survey.

$\frac{1}{100000}$, 3 sheets, Anglo-German Boundary Commission, west of the lake.

It was hoped that during the past year the first sheets of the systematic survey would have been published. But the sheets have been detained in Uganda.

(vii.) Financial.

The estimated expenditure for the year 1906–07 was—£9,924, and for 1907–08 is £9,784; these sums include the cost of the Land Office.

Difficulties of Survey Work in Africa.

It is important to avoid looking upon a survey department in Tropical Africa as working under reasonably favourable conditions. In the protectorate in question it is necessary to note several causes which increase the difficulties of the surveyor's task; and first of these comes the haze which settles down upon the land at certain periods and lasts sometimes for weeks, sometimes for months. The origin of the haze is not known, no doubt a small share is to be credited to the grass and bush fires which occur twice in each year. Certain survey operations are rendered absolutely impossible during the haze, and all operations are hindered. Next amongst the difficulties is to be mentioned the want of a subordinate staff. Then the sleeping sickness obliges a restriction or even a suspension of work in the neighbourhood of the lake. And lastly, in the clear seasons the high grass immensely increases the labour of laying out property boundaries—a work upon which the tranquillity of the country largely depends.

V.

HYDROGRAPHIC SURVEYS.

The Victoria Nyanza.

The survey of Lake Victoria was carried out by Commander B. Whitehouse upon a scale of $\frac{1}{4}$ inch = 1 geographical mile. It represents upwards of 3,200 miles of coast line and sufficient examination of the depths for the requirements of present navigation. The more important anchorages and harbours have been examined in greater detail, Entebbe Harbour and Namaungu Anchorage having been surveyed on a scale of 12″ = 1 geographical mile, Lubembe Harbour, Munyonyo (Port of Kampala), Shirati Bay, Bukoba Roadstead, Entebbe Bay, Port Florence, Mizinda Bay have been surveyed on a scale of 6″ = 1 geographical mile.

The general chart of the Southern portion is in course of publication at the Admiralty, that of the Northern was published in 1902, and the above mentioned large scale plans will be published in due course.

This work was carried out single-handed by Commander Whitehouse under circumstances of considerable difficulty. Great credit is due to this officer for the successful execution of this important survey.

Lake Nyasa.

Lieutenants E. L. Rhoades and W. B. Phillips, R.N.R., completed a survey of Lake Nyasa, and the results of their work is contained in a map published by the Royal Geographical Society in 1902. Scale $\frac{1}{1000000}$. The map gives soundings and sections.

VI.

CLASSIFIED LISTS OF THE STAFFS OF THE SURVEY DEPARTMENTS.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	BRITISH CENTRAL AFRICA.				
Director of Public Works and Survey.	T. J. Binnie	450–600, by £25.	£100 personal ...	Permanent ...	1st Dec., 1900.
Assistant Surveyor	T. J. Firr	325–425, by £20.	2*s.* 6*d.* a day, tent allowance.	„ ...	25th May, 1902.
„ „	J. Barnerman	250–325, by £15.	„ „ „	„ ...	1st June, 1901.
„ „	G. N. Beaumont	200–300, by £10.	„ „ „	3 years' agreement	5th Dec., 1905.
	EAST AFRICA.				
	Superintending Staff.				
Director of Surveys	Major G. E. Smith, R.E. ...	800	... ...	3 years	—
Clerk and Storekeeper ...	Mr. A. Rehm	250	... ...	... ...	4th Jan., 1906.
	Trigonometrical Branch.				
Deputy Director of Surveys ...	Capt. G. S. Knox, R.E. ...	667	... ...	3 years	16th March, 1906.
Assistant „ „ ...	Lieut. E. W. Cox, R.E. ...	525	... ...	„	16th March, 1906.

Surveyor	Coy. Sgt.-Major H. Cox, R.E.	285	... ...	,, ...	16th March, 1906.
,, ...	Corpl. W. Macdonald, R.E. ...	215	... ...	,, ...	28th April, 1906.
	Cadastral Branch.				
Deputy Director of Surveys ...	Mr. E. L. Waring	500	... ...	... ...	1st April, 1906.
Assistant ,, ,, ...	Mr. A. E. Townsend	400	... ...	... ...	August, 1906.
District Surveyor	Mr. T. H. Galbraith	360	... ...	3 years	—
,, ,, ...	Mr. J. P. Clark	360	... ...	... ...	14th July, 1904.
Senior Staff Surveyor ...	Mr. F. M. Lamb	300	... ...	3 years	—
,, ,, ,, ...	Mr. F. C. Kyle	300	... ...	... ...	15th July, 1904.
,, ,, ,, ...	Mr. L. H. Lloyd	300	... ...	3 years	15th July, 1904.
,, ,, ,, ...	Mr. G. Woodruff	300	... ...	... ...	—
,, ,, ,, ...	Mr. W. Nightingale	300	... ...	... ...	—
Junior Staff Surveyor ...	Mr. F. Lind	250	... ...	... ...	—
,, ,, ,, ...	Mr. F. Smyth	250	... ...	... ...	—
,, ,, ,, ...	Mr. J. Marsengo	250	... ...	... ...	—
,, ,, ,, ...	Mr. A. Bessler	250	... ...	... ...	—
,, ,, ,, ...	Mr. J. Spalding...	250	... ...	3 years	—
Chief Computer and Examiner	Mr. Panting	200	£40 house allowance	... ...	—
Clerk and Accountant ...	Mr. G. Bunting...	175	,, ,, ,,	... ...	—
Assistant Clerk and Accountant.	Mr. Clark	140	,, ,, ,,	... ...	—
	GOLD COAST.				
Director of Surveys	Major F. G. Guggisberg, R.E.	100	A month.		
Deputy Director of Surveys ...	Capt. C. B. O. Symons, R.E. ...	60			
Senior Surveyor	L.-Corpl. G. V. Mathieson, R.E.				
Junior Surveyor	2nd Corpl. R. N. Kilby, R.E....				
,, ,, ...	2nd Corpl. G. Strickland, R.E.				

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	GOLD COAST—*continued.*				
Draughtsman	2nd Corpl. J. W. Walsh, R.E.				
Native Assistant Surveyors and Draughtsmen (1st Class)	J. B. Esuwan-Gwira				
" " " (2nd Class)	E. J. Smith				
" " " "	T. H. Vaughan				
" " " "	R. Josiah				
	SOUTHERN NIGERIA.				
Director of Surveys	Mr. E. P. Cotton	700	£100 duty allowance	Pensionable ...	29th Oct., 1906.
Deputy Director of Surveys ...	Mr. A. Cleminson	400–500, by £20.	... ...	" ...	1st Jan., 1907.
Senior Surveyor	Mr. M. Olphert...	300–400, by £20.	... ...	" ...	1st Jan., 1907.
Junior Surveyor	Mr. F. W. H. Black	350	... ...	Non-pensionable, by agreement.	17th Aug., 1905.
" "	Mr. R. A. Webb	350	... ...	" " "	17th Aug., 1905.
" "	Mr. R. L. Drouyn	350	... ...	" " "	17th Oct., 1905.
" "	Mr. W. S. Sloan	250	... ...	" " "	30th May, 1905.
Draughtsman	Mr. W. J. F. Lomas	350	... ...	" " "	13th Oct., 1906.
	UGANDA.				
Director of Surveys	Mr. R. C. Allen...	500–700, by £25.	... ...	... ...	30 Nov., 1900

Deputy Director of Surveys ...	Mr. W. V. Morris	325–425, by £20.	... ...	... ...	27th July, 1902.	
Assistant Director of Surveys	Capt. H. S. Toppin	350	... ...	3 years' agreement (Service extended to October, 1907).	8th April, 1904.	
Senior Surveyor	Mr. E. Richardson	350	... ...	3 years' agreement (Re-engaged for 3 years).	8th April, 1904.	
,, ,, ...	Mr. E. G. Fenning	350	... ...	3 years' agreement (Re-engaged).	18th April, 1904.	
,, ,, ...	Mr. L. R. Fraser	350	... ...	3 years' agreement	18th April, 1904.	
,, ,, ...	Mr. H. E. Winckler	350	... ...	3 years' agreement	12th June, 1904.	
Junior Surveyor	Mr. L. M. Seth-Smith	300	... ...	3 years' agreement	3rd June, 1904.	
,, ,, ...	Mr. A. Richardson	300	... ...	3 years' agreement (Re-engaged for 30 months).	1st June, 1903.	
,, ,, ...	Mr. J. T. W. S. McGregor ...	300	... ...	3 years' agreement (Re-engaged for 3 years).	17th July, 1903.	
,, ,, ...	Mr. H. Boazman	350	... ...	3 years' agreement (Re-engaged for 30 months, 12/2/07).	17th July, 1903.	
,, ,, ...	Mr. J. P. Tolland	300	... ...	3 years' agreement from date of arrival in Africa (not reported).	—	
,, ,, ...	Mr. J. T. Stiles...	300	... ...	,, ,, ,,	—	
,, ,, ...	Mr. A. H. Gee	300	... ...	,, ,, ,,	—	
,, ,, ...	Mr. R. J. Goulston	300	... ...	,, ,, ,,	—	
,, ,, ...	Mr. V. F. Mayne	300	... ...	,, ,, ,,	—	
,, ,, ...	Mr. A. C. Willmott	300	... ...	,, ,, ,,	—	

COLONIAL REPORTS.

The following recent reports relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
500	Colonial Survey Committee	1905–1906
501	Grenada	1905
502	Straits Settlements	"
503	Gibraltar	"
504	Trinidad and Tobago	1905–1906
505	St. Lucia	1905
506	Mauritius	"
507	Southern Nigeria (Lagos)	"
508	Somaliland	1905–1906
509	Fiji	1905
510	St. Vincent	1905–1906
511	Sierra Leone	1905
512	Southern Nigeria	"
513	Basutoland	1905–1906
514	British Guiana	"
515	British Honduras	1905
516	Northern Nigeria	1905–1906
517	Bechuanaland Protectorate	"
518	Leeward Islands	"
519	East African Protectorate	"
520	Seychelles	1906
521	Hong Kong	"
522	Falkland Islands	"
523	Ashanti	"
524	Jamaica	1905–1906
525	Uganda	"
526	St. Helena	1906
527	Ceylon	"
528	Bermuda	"
529	Gibraltar	"
530	Northern Territories of the Gold Coast	"
531	Sierra Leone	"

MISCELLANEOUS.

No.	Colony.	Subject.
32	Northern Nigeria	Mineral Survey.
33	Southern Nigeria	Do.
34	Montserrat	Agricultural Industry.
35	Antigua and St. Kitts-Nevis	Sugar.
36	West Indies	Work of Imperial Department of Agriculture.
37	Ceylon	Mineral Survey, 1904–5.
38	St. Helena	Agriculture.
39	Jamaica	Cayman Islands.
40	Northern Nigeria	Taxation of Natives.
41	East Africa Protectorate ...	Report on Kenia Forests.

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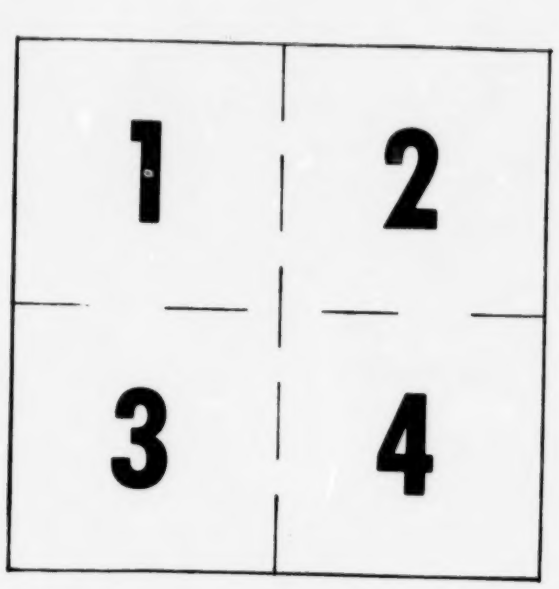
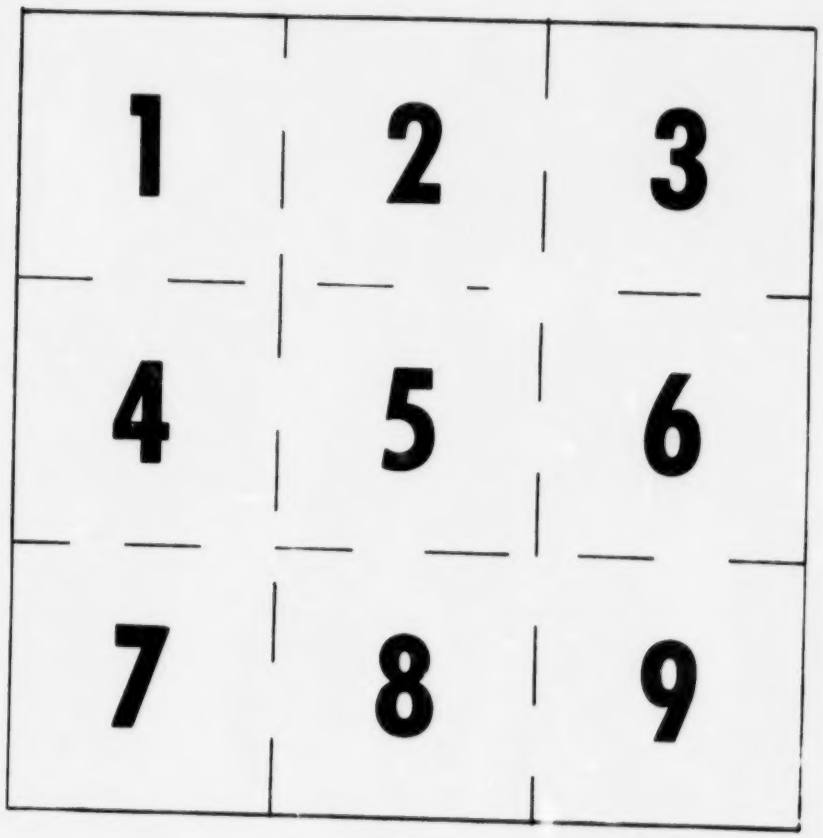
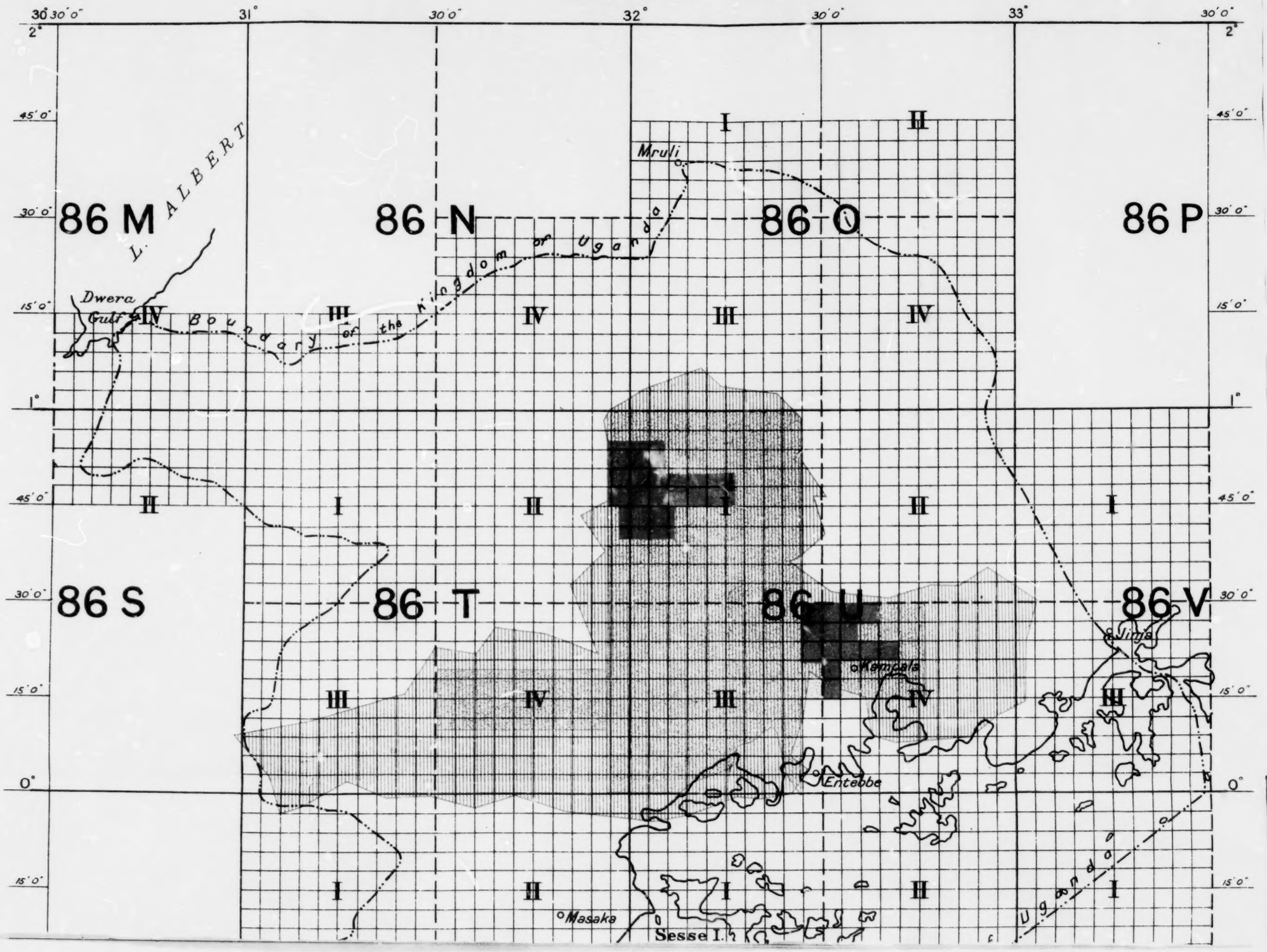




KINGDOM OF UGANDA

INDEX PLAN



86 S

86 T

86 V

93 A

93 B

93 C

93 D

Entebbe

Masaka

Sesse I.s

Jinja

L A K E V I C T O R I A

Uganda

Boundary of the King

Area over which observations have been completed with Theodolite for the 1/25,000 Survey.

Area in which the Field Sheets for the 1/25,000 Scale have been completed.

Area in which the Field Sheets for the 1/10,000 Scale have been completed.

Sheets of the 1/250,000 Series numbered as 86-T

Sheets of the 1/25,000 Series numbered as 86-T IV

Sheets of the 1/10,000 Series numbered.

T.S.G.S. Nº 2223.

Scale, 1/1,267,200 or 1 Inch to 20 Miles

MILES 10 0 20 40 60 80 100 MILES

War Office. Nov.r 1906.

COLONIAL REPORTS—ANNUAL.

No. 565.

THE SURVEYS
OF
BRITISH AFRICA,
CEYLON,
AND THE
FEDERATED MALAY STATES.

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

THIRD YEAR.

To June, 1908.

(For Report for 1906–7, *see* No. 532.)

Presented to both Houses of Parliament by Command of His Majesty.
July, 1908.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY DARLING & SON, LTD., 34-40, BACON STREET, E.

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1908.

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An iron survey quadripod centred over a cement observation pillar for astronomical and trigonometrical observations.

No. 565.

COLONIAL SURVEY COMMITTEE REPORT, JUNE, 1908.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

R. C. HELLARD, *Colonel.*
H. J. READ.
C. F. CLOSE, *Major, Gen. Staff.*

W. C. BOTTOMLEY, *Secretary.*
16th July, 1908.

1125 Wt 24282 7/08 D & S 5 32706 A 2

I.

REVIEW OF THE WORK OF THE PAST YEAR.

Topographical Surveys.—A total area of about 56,500* square miles has been topographically surveyed in British Africa during the past year, as under :—

Orange River Colony	7,300	sq. miles.
Cape Colony	17,000	„ „
Basutoland	2,500	„ „
Uganda	13,000	„ „
Gold Coast	15,000	„ „
N. Nigeria	1,700	„ „

Rough Surveys and Explorations are being carried out in the Anglo-Egyptian Sudan, and Sierra Leone.

Geodesy.—The work of measuring about 2½° of the arc of the 30° meridian to the west of Uganda is being carried out in conjunction with the Congo Government. It is expected that the measurement will be completed in the course of this summer.

Cadastral Surveys have been in progress in the Anglo-Egyptian Sudan, Gold Coast, Uganda, and East Africa.

It is satisfactory to be able to record a very considerable reduction of the arrears of surveys required for land conveyancing in East Africa.

Boundary Commissions.—Three Commissions have been at work during the past year :—

(i.) The Niger-Chad Commission (British Commissioner Major O'Shee, R.E.) has delimited and beaconed the northern frontier of Northern Nigeria from the Niger to Lake Chad, as required by the Anglo-French protocol of the 9th April, 1906.

(ii.) The Uganda-Congo Commission (British Commissioner Lieut.-Col. Bright, C.M.G., Rifle Brigade) has completed the surveys of the frontier zone from the south of Lake Albert Edward, past Ruwenzori to the western shores of Lake Albert.

(iii.) The Anglo-German, Yola-Cross River, Commission (British Commissioner Lieut.-Col. Whitlock, R.E.) has completed the survey of the boundary from Yola as far south as the frontier of Southern Nigeria.

* Excluding the area surveyed by the Niger-Chad Boundary Commission.

Altogether 1,300 linear miles of frontier have been surveyed during the year.

Catalogue of Published Maps.—A catalogue of the maps published by the Topographical Section of the General Staff has been issued, for the first time, this year. The catalogue contains, *inter alia*, a complete list of all official maps of Africa purchasable by the public, and is provided with index diagrams which show the incidence of the published sheets.

NOTE.—This report differs from those of 1906 and 1907 in that it is not entirely confined to a consideration of the surveys of British Africa but also contains an account of the surveys of Ceylon and of the Federated Malay States. The reason for this is that it has been considered desirable to record briefly the state of the surveys of those countries as determined by the inspection in 1907.

II.

REGULATIONS AFFECTING SURVEY DEPARTMENTS.

(i.) THE SPELLING OF AFRICAN PLACE NAMES.

The Secretary of State has approved of the following rules for the spelling of place names in British Tropical Africa :—

(*a*) Established forms of spelling of well known places are to be retained, *e.g.*, Coomassie, Accra.

(*b*) The spelling of other place names is to be in accordance with the rules of the Royal Geographical Society. (Briefly, in this system, the consonants are as in English and the vowels as in Italian.)

(*c*) The Director of Surveys in each Colony or Protectorate (or where there is no Director of Surveys, the Intelligence Officer), is responsible for the correctness of the spelling of the place names on field sheets sent home for reproduction. He will ascertain the true pronunciation from Commissioners and Residents.

In any case in which it is doubtful whether a name should be dealt with under (*a*) or (*b*) he will refer the question to the Governor for decision.

(ii.) INSTRUCTION IN SURVEYING.

Arrangements have been made for civil and military officers in Colonial employment who are home on leave, to be instructed in surveying at the Ordnance Survey, Southampton. The

instruction can be arranged for at any time of the year except during the month of September, during which month no class will be held. The instruction would usually last for one month. Officers and officials who desire to go through such a course should, as a rule, apply for permission before coming home, naming the approximate dates that would be convenient to them.

(iii.) Appointments to Survey Departments.

Candidates for junior appointments in the Survey Departments dealt with in this report, will, if provisionally selected, be sent to the Ordnance Survey, Southampton, for a month's course of instruction in surveying. If during this course the Director General of the Ordnance Survey reports that the candidate is unfitted for the post to which he has been provisionally appointed, the candidate will be withdrawn from the course, and will not receive the appointment.

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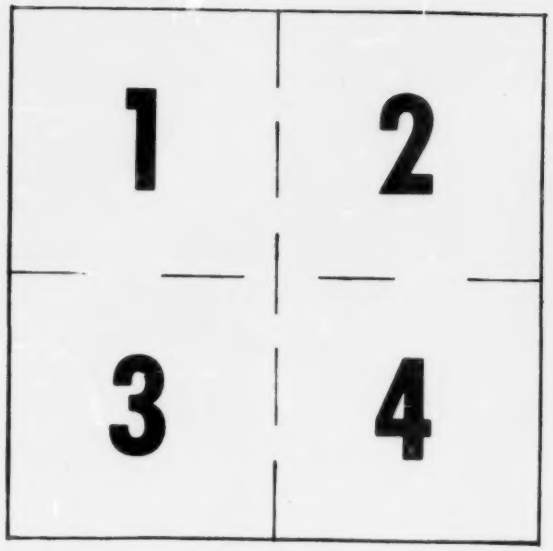
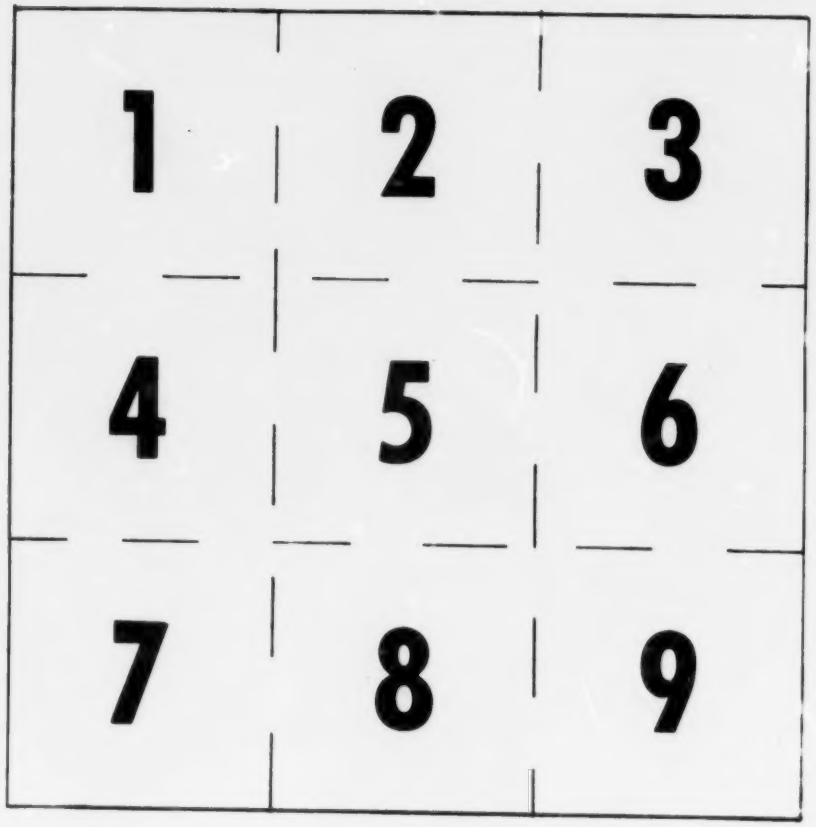




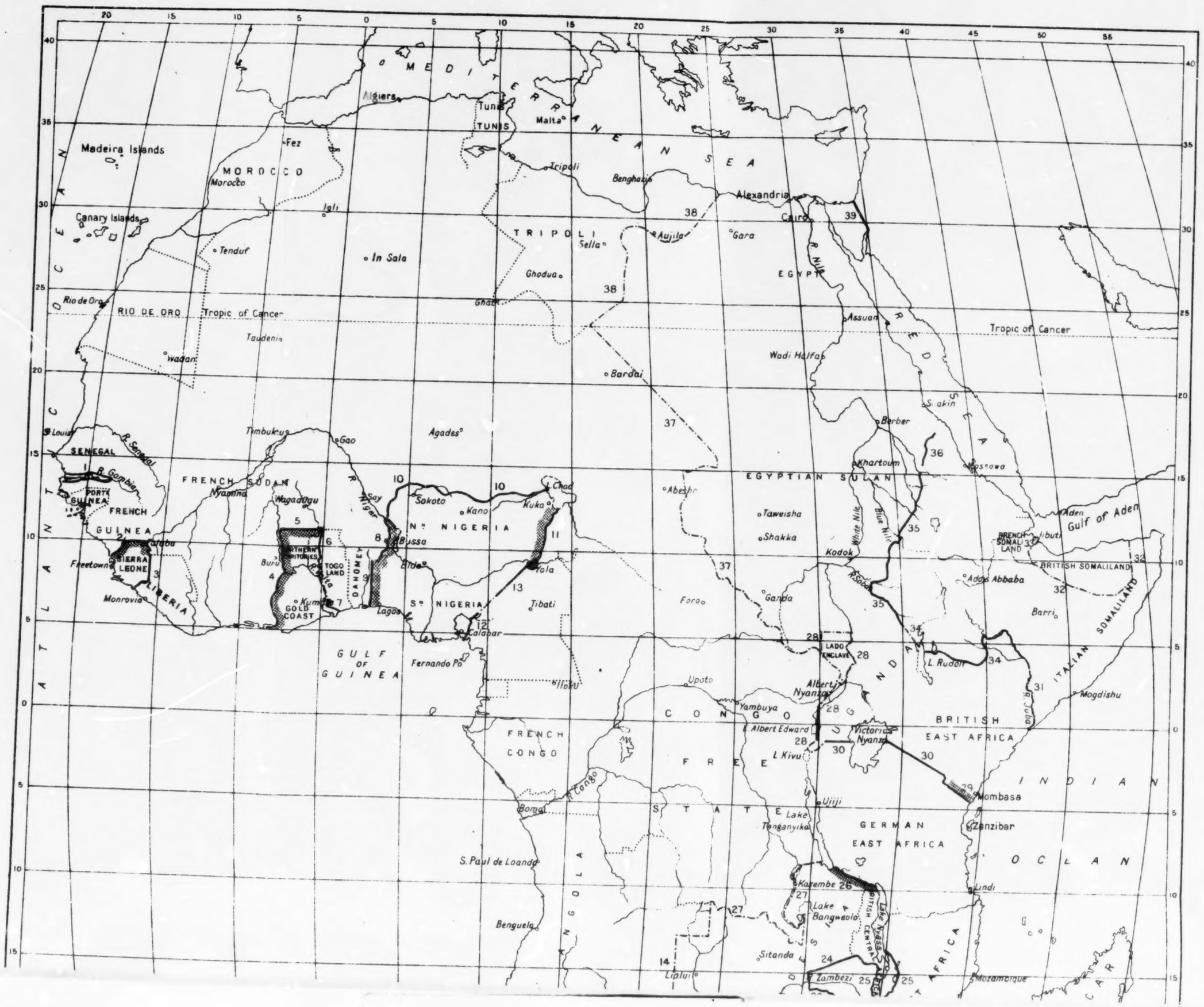

ATLANTIC OCEAN
MEDITERRANEAN SEA
INDIAN OCEAN
Madeira Islands
Canary Islands
MOROCCO
Morocco
Fez
Igli
In Sala
Tendut
Rio de Oro
RIO DE ORO
Tropic of Cancer
Taudenia
Wadan
Algiers
Tunis
TUNIS
Malta
Tripoli
Benghazi
Sella
Aujila
Ghadua
Ghat
Gara
Alexandria
Cairo
EGYPT
R. Nile
Assuan
Wadi Halfa
Bardai
Tropic of Cancer
RED SEA
Berber
S. akin
Khartoum
Abeshr
Taweisha
Shakka
Kodok
White Nile
Blue Nile
EGYPTIAN SUDAN
Aden
Gulf of Aden
BRITISH SOMALILAND
Addis Abbaba
Barri
ITALIAN SOMALILAND
Mogdishu
Gonda
Foroo
Tibati
Upoto
Yambuya
Albert Nyanza
L. Rudolf
LADO ENCLAVE
BELGIAN CONGO
FRENCH CONGO
FREE STATE
BRITISH EAST AFRICA
GERMAN EAST AFRICA
L. Albert Edward
Victoria Nyanza
L. Kivu
Uiiji
Lake Tanganyika
Mombasa
Zanzibar
Lindi
Kazembe
Lake Bangweolo
Sitanda
Zambezi
Mozambique
Liatui
Benguela
S. Paul de Loanda
ANGOLA
Bomal
R. Congo
GULF OF GUINEA
Fernando Po
Calabar
Lagos
Kumasi
GOLD COAST
TOGO LAND
DAHOMEY
Bida
Bussa
Kano
Sokoto
Kuka
Chad
Yola
N. NIGERIA
S. NIGERIA
Say
R. Niger
Agades
Timbuktu
Gao
Wagadugu
Nyamina
FRENCH SUDAN
R. Senegal
R. Gambier
SENEGAL
PORT GUINEA
FRENCH GUINEA
Freetown
SIERRA LEONE
Monrovia
LIBERIA
St Louis
Grabu
Buru
Kete
Lake Nyasa
Tropic of Capricorn
AFRICA
CAR

DIAGRAM TO ILLUSTRATE THE PROGRESS OF THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA

Scale of the Diagram
26,512,000 or 1 inch to 450 Miles
Miles 100 0 100 300 500 700 900 Miles

British Boundaries marked & ratified
Do Do surveyed
Do Do not yet surveyed

SENEGAL
FRENCH GUINEA
PORTUGUESE GUINEA
SIERRA LEONE
LIBERIA
FRENCH SUDAN
GOLD COAST
TOGOLAND
DAHOMEY
S^N NIGERIA
N^N NIGERIA
GULF OF GUINEA
Fernando Po
FRENCH CONGO
ANGOLA
Benguela
S. Paul de Loanda
Boma
EGYPTIAN SUDAN
Khartoum
Massawa
Abessinia
Taweisha
Shakka
Kodok
Gulf of Aden
BRITISH SOMALILAND
ITALIAN SOMALILAND
Addis Abbaba
Barri
Mogdishu
Ganda
Foro
Tibati
Upoto
Yambuya
Albert Nyanza
L. Rudolf
LADO ENCLAVE
CONGO FREE STATE
L. Albert Edward
L. Kivu
Victoria Nyanza
BRITISH EAST AFRICA
GERMAN EAST AFRICA
Mombasa
Zanzibar
INDIAN OCEAN
Ujiji
Lake Tanganyika
Kazembe
Lindi
Lake Bangweolo
Lake Nyassa
BRITISH CENTRAL AFRICA
PORTUGUESE EAST AFRICA
Mozambique
Sitanda
Lambezi
Liuli
Ndara
Victoria Falls
Salisbury
Kilimane
Sofala
Moremi
Bulawayo
GERMAN SOUTH WEST AFRICA
Walfish Bay
Tropic of Capricorn
Inhambane
TRANSVAAL
Pretoria
Lorenco Marques
Geshagy
Kuruman
Kimberley
Port Nolloth
ORANGE RIVER COLONY
Bloemfontein
NATAL
Durban
CAPE COLONY
Cape Town
Port Elizabeth
MADAGASCAR

T.S.G.S. Nº 2226 (a)

War Office. August 1906.
Revised June 1908

TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed	Dates of Finally approved.	REMARKS.
1	Gambia (Anglo-French)	425	Aug. 10th, 1889	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Lecomte, Civil Administrator.	Nov., 1890, to May, 1891	May, 1891	June 9th, 1891.	—	—
1	" "	—	" "	British :— Mr. Reeve. Mr. Ozanne. French :— M. Fargue. Lieut. de Jussien. M. Robert (Interpreter).	1895-6.	—	—	—	—
1	" "	—	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898-9.	—	—	—	—
1	" "	—	April 8th, 1904	British :— Major Cowie, W.I.R.	1905-6.	—	—	—	—
2	Sierra Leone—French Guinea.	260	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Capt. A. H. Kenney, R.E. French :— M. Lamadon, Governor of the French Colony of Les Rivières-du-Sud.	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembi-Kunda.
2	" "	—	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Millot.	Dec., 1895, to May, 1896.	1895, 1896	April 9th and 30th, 1896.	June 14th and 16th, 1898.	From the Coast to Tembi-Kunda.

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	REMARKS.
2	Sierra Leone—French Guinea.	8	Aug. 10th 1889, Jan. 21st, 1895.	British :— Mr. Birch. French :— M. Vescure.	1900 and Jan. 15th, 1903.	1903.	Mar. 12th, 1903.	Exchange of notes, Mar. 22nd and April 5th, 1904.	Temli - Kundu Eastwards.
3	Sierra Leone—Liberia ..	195	Nov. 11th, 1885	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E. Liberian :— Mr. J. McCarthy.	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	—	—
4	Gold Coast—Ivory Coast (Anglo-French).	450	July 12th, 1893	British :— Major A. E. G. Watherston, R.E. Capt. Soden, R. Fus. Capt. H. B. Des Voeux, R.E. French — M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903.	Feb. 1st, 1903.	May 11th and 15th, 1905.	—
5	Gold Coast, Northern Territories — French Sudan, Senegambia-Niger (Anglo-French Boundary North of Gold Coast).	195	Convention, June 14th 1898.	British :— Major A. E. G. Watherston, R.E. Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	—	Aug. 16th, 1901.	—	—
5	" "	"	Agreement, Mar. 18th/ April 25th, 1904.	British :— Capt. J. O'Kinealy. French :— Lieut. F. Verlaque.	—	1904.	Oct. 15th, 1904.	May 24th/ July 19th, 1906.	—
6	Gold Coast, Northern Territories — Togo (Anglo-German).	165	Convention, Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E. Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried.	Dec., 1901, to Sept., 1902.	—	July 21st, 1902.	—	—

6	" "	"	" "	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.	—	Sept., 1904, to Dec. 15th, 1905.	—	June 25th, 1904.	North of 9th parallel only.
7	Gold Coast — Togoland (Anglo-German).	125	Convention, July 1st, 1890.	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	1904.	Oct. 11th, 1904.	—	—
8	Lagos—Dahomey (Anglo-French).	235	June 14th, 1898	British :— Major J. I. Lang, C.M.G., R.E. French :— Commdt. Touteé.	1900.	—	Dec. 22nd, 1900, and Jan., 1905.	Oct. 19th, 1906.	From 9° N. Lat. to Niger.
9	" " ..	200	August 10th, 1889, July 12th, 1893.	British :— Mr. F. C. Fuller. Mr. A. G. Fowler. Dr. Hay. French :— Capt. J. Plé. Lieut. Brisson.	1895-6.	—	Oct 12th, 1896, Art. II. June 14th, 1898.	Oct. 19th, 1906.	From the Coast to 9° N.Lat. Treaty Series No. 15, 1898.
9	" " ..			British :— Capt. Anderson. French :— M. Perreur.	1900.	—	—	—	—
10	Niger—Chad (Anglo-French).	860	June 14th 1898, April 8th, 1904.	British :— Lieut.-Col. G. S. McD. Elliott, R.E. Capt. C. H. Foulkes, R.E. Capt. G. R. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty. Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906, May 29th, 1906.	—	—
10	" " ..	"	May 29th, 1906	British :— Major R. F O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Andoin. Lieut. Vignon.	1906, 1907.	1907, 1908.	Feb. 25th, 1908.	—	—

Changes in notes, exchange

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
11	Yola–Chad (Anglo-German).	350	Convention, Nov. 15th, 1893. Preliminary Agreement, Dec. 2nd, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E. Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B. Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Aug. 10th, 1903, Feb., 1903, to Feb., 1904 and 1905.	—	Feb. 24th, 1904, and Mar. 19th, 1906.	July 16th, 1906.	(Treaty Series No. 17, 1906).
11	" "	40	" "	Local Commission to mark Boundary :— British :— Mr. Hans Fischer. German :— Leut. von Stephani.	—	1906 to 1907.	Feb. 12th, and Mar. 11th, 1907.	—	From Gorege to Lake Chad.
11		81	" "	British :— Capt. Vicars Boyle. German :— Capt. von Stephani.	—	1907.	Mar. 11th, 1907.	—	From Uba, on Yeneseram River, to River Benue.
12	Cross River (Southern Nigeria–Kameruns).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug. 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th, 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1895.	—	—	—	Cross River to the Sea.
12	" "	"	" "	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	—

13	Cross River Rapids—Yola Arc.	285	Nov. 15th, 1893	British :— Lieut-Col. G. F. A. Whitlock, R.E. Capt. H. T. G. Moore, R.E. Lieut. W. V. Nugent, R.A. 2nd Lieut. W. D. Downes, Royal Sussex Regiment. German :— Major Haering. Oblt. von Stephani. Oblt. Cuno. Oblt. Rothe.	1907	—	—	—	—
14	Barotseland—Angola ..	710	Convention, July 11th, 1891, and Arbitration award, May 30th, 1905.	—	—	—	—	—	Not yet delimited.
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	—	—	—	—	—	Not yet delimited.
16	Bechuanaland—German South-West Africa.	1113	July 1st, 1890, Art. III. (A.G.); Dec 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British :— Major H D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1898 to 1903.	—	—	Part only of boundary delimited.
16	Cape Colony—German South-West Africa (Orange River).		July 1st 1890, Art. III.	—	—	—	—	—	Not yet delimited.
17	Amatongaland — Portuguese East Africa.	30	June 11th, 1891, Art. III.	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	Aug., 1896, to Dec., 1896	—	—	—	—
17	" "	"	" " "	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	—	Aug. and Oct., 1897.	Oct. 2nd, 1897.	Dec. 29th, 1898/Jan. 25th, 1899.	—
18	Swaziland—Portuguese East Africa.	65	Conference, April to June, 1907.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1888, 1894, and 1897.	April, 1907	—	—	Portuguese and Boer Commission.

Red Nos. on Map.	Name of Boundary.	Length, Miles	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved	REMARKS.
19	Transvaal — Portuguese East Africa.	255	July 29th, 1869. Convention of London, Feb. 27th, 1881.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1887, 1890, and 1894.	1887, 1890, 1891.	—	—	Portuguese and Boer Commission.
20	Limpopo River to Sabi River (Anglo - Portuguese).	115	June 11th, 1891	British :— Mr. W. J. Atherstone. Portuguese :— José A Serrano.	Dec. 1902, to July, 1903.	—	Dec. 21st, 1903/July 19th, 1904.	June 3rd, 1907.	In one exchange of notes.
21	Mazoe or Manica Boundary (Anglo - Portuguese 18° 30′ S. to Sabi River).	235	June 11th, 1891, and Arbitral award, Jan. 30th, 1897.	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	June 3rd, 1907.	In one exchange of notes.
21	" "	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade.	—	1898, 1899.	June 5th and 28th, 1898, and Dec. 14th and 15th, 1898.	—	—
22	Barue Boundary (Anglo-Portuguese, River Mazoe, and 18° 30′ South).	145	June 11th, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E.	1898.	1905 to	Dec. 28th, 1898.	Mar. and April, 1902, Jan. and April, 1904.	Exchange of notes.

23	Anglo-Portuguese Boundary South of River Zambesi.	215	June 11th, 1891	British :— Mr. Sawerthal. Portuguese :— Lieut. Durao.	1903-4	—	—	—	Provisional survey.
23	" "	215	"	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. S. Gugo Coutinho.	April 1905, to Oct., 1905.	1905.	Oct. 4th, 1905.	—	—
24	Anglo-Portuguese Boundary North of Zambesi.	260	" "	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. S. Gugo Coutinho.	June, 1904, to Nov., 1904.	1904.	[Nov, 21st, 1904.	—	—
25(a)	Nyasaland Protectorate —Portuguese East Africa (Anglo-Portuguese).	660	" "	British :— Mr. J. F. Cunningham. Mr. T. J. Binnie, Surveyor. Portuguese :— Capt. Ferraz. Conde. Du Pont. Capt. Branco.	July to Nov., 1899. Oct. to Dec., 1900.	1899-1900.	Dec. 8th, 1900.	*Sept. 15th, 1906.	Section from River Ruo to Lake Chiuta — Provisional Boundary Commission.
25(b)	" "			British :— Mr. A. James Swann. Mr. Thomas J. Binnie, Surveyor.					
25(c)	" "	91	" "	Local Commission :— British :— Mr. A. J. Swann. Mr. T. F. Firr, Surveyor. Portuguese :— 2nd Lieut. Antonio de Brito.	—	1907.	—	—	To make some alterations to previous line. Beaconed from B. P. 38 to Mt. Kapirinta.
26	Nyasa-Tanganyika (Anglo-German).	225	July 1st, 1890	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Boileau, R.E. Capt. Chichester. Lieut. Scratchley. German :— Hptmann Herrmann. Leut. Glauning. Dr. Kohlschütter.	1898.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—

* Provisional confirmation of recommendations of Boundary Commissioners, 1899 and 1900 (Procés Verbal, December 8th, 1900).

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
27	Congo Free State—North-West Rhodesia.	1,200	May 12th, 1894	—	—	—	—	—	Not yet delimited.
28	Congo Free State—Uganda and Sudan.	800	May 12th, 1894, and May 9th, 1906.	British :— Lieut.-Col. R. G. T. Bright, C.M.G., Rifle Brigade. Capt. E. M. Jack, R.E. Lieut. Hon. F. R. D. Prittie, Rifle Brigade. Congolese :— (?)	Jan., 1907, to present.	—	—	—	—
29	British — German East Africa (Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith, R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 26th, 1893.	—	—
29	" " "	"	July 25th, 1893	British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897.	1900.	Jan. 28th, Feb. 14th, and April 25th, 1900.	—	Not beaconed throughout its entire length.
30	British — German East Africa (South end of Jipe to Lake Victoria).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	—
30	German East Africa—Uganda.	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	July, 1902, to Apr. 1904.	1904.	July 18th, 1906.	—	—

31	Italian Somaliland — British East Africa.	375	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
31(*a*)	British Somaliland — Abyssinia.		May 14th, 1897, June 4th, 1897.	—	—	—	—	—	Not yet delimited.
32	British Somaliland — Italian Somaliland.	710	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
33	British Somaliland — French Somali Coast.	50	February 2nd, 1888 ..	—	—	—	—	—	Not yet delimited.
34	Uganda and East Africa —Abyssinia Boundary.	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900–01.	—	—	—	—
34	" " "	"	—	Capt. P. Maud, R.E. Mr. J. Baird.	Oct. 1902, to July, 1903.	—	—	—	—
34	" " ..	"	December 6th, 1907 ..	—	—	—	—	—	—
35	Sudan—Abyssinia ..	760	Treaty, May 15th, 1902	Major H. H. Austin, R.E. Lieut. C. W. Gwynn, R.E.	—	—	—	—	—
35	" " ..	"	" " "	Brev.-Major C. W. Gwynn, R.E., D.S.O.	1903.	1903.	—	—	—
36	Sudan—Eritrea	330	December 7th, 1898, June 1st, 1899, April 16th, 1901, November 22nd, 1901, May 15th, 1902.	British :— Col. the Hon. M. G. Talbot, R.E. Italian :— Major Martinelli. Tenente. A. Pollera. Capt. Tornare.	1903.	—	—	—	R. Stetit to Abu Gamal.
36	" " ..	"	" " "	Brev.-Major W. J. Walter, Lancs. Fus.	1899, 1901.	—	—	—	From Sabderat North - Eastwards.
37	Anglo - French — From Congo-Nile Watershed to Tripoli.	1,950	March 21st, 1899 .. Treaty, Series 15, 1899.	—	—	—	—	—	Not yet delimited.
38	Egypt—Tripoli	1,000	—	—	—	—	—	—	Not yet delimited.
39	Egypt—Turkish, Sinai Peninsula.	140	Firman, 1841	British :— Capt. R. C. Owen. Mr. Wade. Mr. Keeling. Turkish :— Mazzaffer Bey. Fehim Bey.	1906.	1906.	—	Oct. 1st, 1908.	—

IV.

REPORTS ON THE SURVEYS

OF

ANGLO-EGYPTIAN SUDAN.
EAST AFRICA.
GAMBIA.
GOLD COAST.
NORTHERN NIGERIA.
NYASALAND.
RHODESIA.
SIERRA LEONE.
SOUTH AFRICA (GENERAL).
THE CAPE COLONY.
THE ORANGE RIVER COLONY.
SOUTHERN NIGERIA.
UGANDA.

THE ANGLO-EGYPTIAN SUDAN.

Sirdar	...	Major-General Sir F. R. WINGATE, K.C.B., K.C.M.G., D.S.O.
Director of Surveys	...	Captain H. D. PEARSON, R.E.
Assistant-Director of Surveys	...	Lieutenant A. E. CONINGHAM, R.E.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but it has been thought desirable to include an account of these surveys in order to make the review of the mapping of British Africa more complete.

The following report has been kindly furnished by the Director of Surveys.

Topographical Work.

In 1906 a triangulation was commenced by Lieutenant Coningham from the previous Kassala-Suakin triangulation in order to fix the positions of certain hills in the mining districts in the neighbourhood of the Egyptian-Sudan Boundary on the 22nd parallel.

The primary object of this survey was accomplished, but a gap remained between this triangulation and Colonel Talbot's triangulation round Murrat, which had been made in 1902.

During 1907-08, in order to complete the Suakin-Murrat chain, as well as to furnish points along the Egyptian border on the 22nd parallel, to which the Egyptian surveyors working down from the north could connect, Lieutenant Coningham's triangulation was further extended to the north and west.

Though a large tract of this very broken country was mapped and the watercourses defined, the actual triangulation was not very successful owing chiefly to water difficulties rendering it impossible to stay for any time at any of the stations. This country is, however, of little value, and the maps produced as the result of the survey will probably prove sufficient for many years to come.

An attempt was also made to extend Lieutenant Coningham's triangulation, commenced in 1906-07, in the neighbourhood of El Obeid, in southern Kordofan, but after a few months' work, owing to some doubt existing as to the reception the survey parties might receive in the southern hills, it was considered advisable to discontinue the work temporarily.

Telegraphic longitudes of some eight stations on the Bahr-el-Jebel and Bahr-el-Zeraf were fixed during the past year.

A sketch map of the desert west of Dongola based on observed latitudes and perambulator traverses showing roads and wells with sufficient accuracy was made during the year.

In addition large numbers of route sketches have been carried out by civil and military officers in the provinces, especially in Kordofan, where the example set by Captain Lloyd, the Governor of the Province, has been keenly followed.

It has been the object of the Survey Department to fix positions astronomically or by triangulation in various parts of the country, as points on which such route sketches can be fitted and so to obtain in as short a time as possible maps of sufficient accuracy, from an administrative point of view, of all parts of the Sudan.

Four sheets of the Sudan on the "million" scale have been published up to date. These sheets have been supplemented locally by temporary sun prints on the same scale and such provisional maps for the whole of the Sudan are now available for local issue.

These maps, though useful for administrative purposes, have been compiled from route sketches only, and no great reliance can be placed on their accuracy.

Cadastral Surveys.

During the year the cadastral surveys of Halfa, Berber, the Gezira and White Nile Provinces have been continued.

In Halfa, during the year some 20,000 acres have been mapped on the $\frac{1}{2500}$ scale.

In Berber, where the cultivation is in larger plots and practically continuous as far as the cataracts south of Abu Hamed, the outturn during the year has been some 40,000 acres.

It is hoped that both these surveys will be completed next season.

In the Gezira, the large tract of cultivable land between the Blue and the White Nile, south of Khartoum, the system of minute squares described in last year's report has been continued. On examination it was found that the native trained surveyors had not justified the confidence placed in them to run lines between posts placed four minutes apart, and though the outer famework remained unaltered, the whole of the detail work had to be corrected during the present year.

New detail work was stopped shortly after its commencement by the recent disturbances.

The season's work will it is hoped enable maps covering some 300,000 acres to be completed. In addition also the stone and brick demarcation has been pushed well in advance, so that when survey work is re-commenced it will continue without interruption.

The White Nile survey, for some 200 miles above Khartoum differs from the other surveys in that it is for the measurement of land which is only uncovered at low water.

The triangulation from Khartoum south has now been completed for about 80 miles, and 15 miles of network of traverse, as yet on one bank only, has been run between trigonometrical stations.

The illness of the settlement officer, who had to be invalided home, made it impossible for any detail work to be undertaken, and this work is temporarily at a standstill.

During the past year the services of one surveyor were placed at the disposal of the Director of Agriculture and Lands for employment in surveying concessions of Government land applied for in Dongola and Berber Provinces.

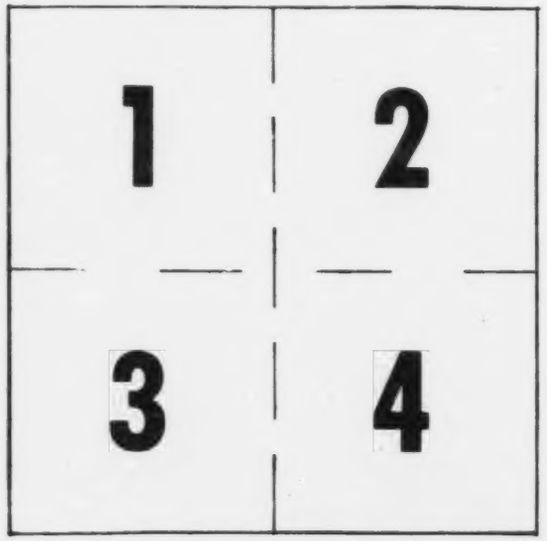
Town Surveys.

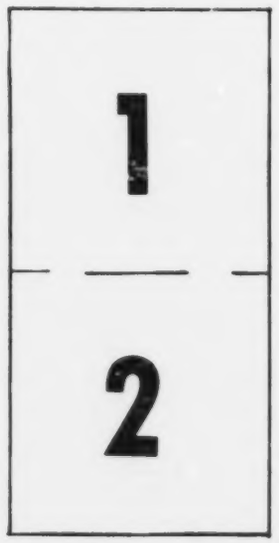
General maps are being made on the $\frac{1}{2500}$ scale.

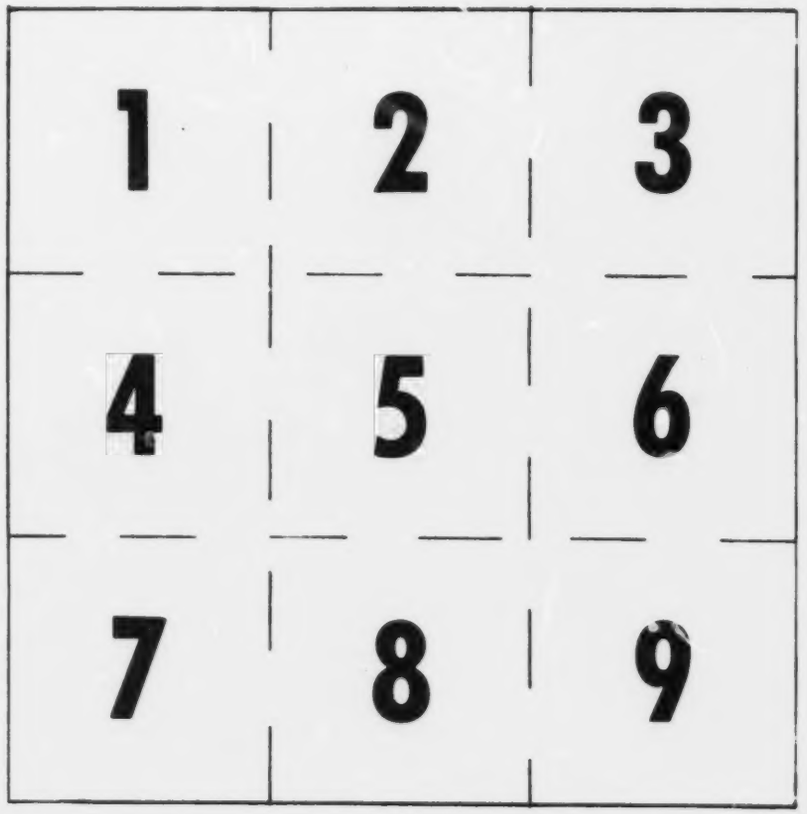
Individual plots are mapped on the $\frac{1}{500}$ scale.

The survey of Port Sudan was completed during the year. Those of Halfa, Berber, El Damar, Shendi and Gedaref are now in hand.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.

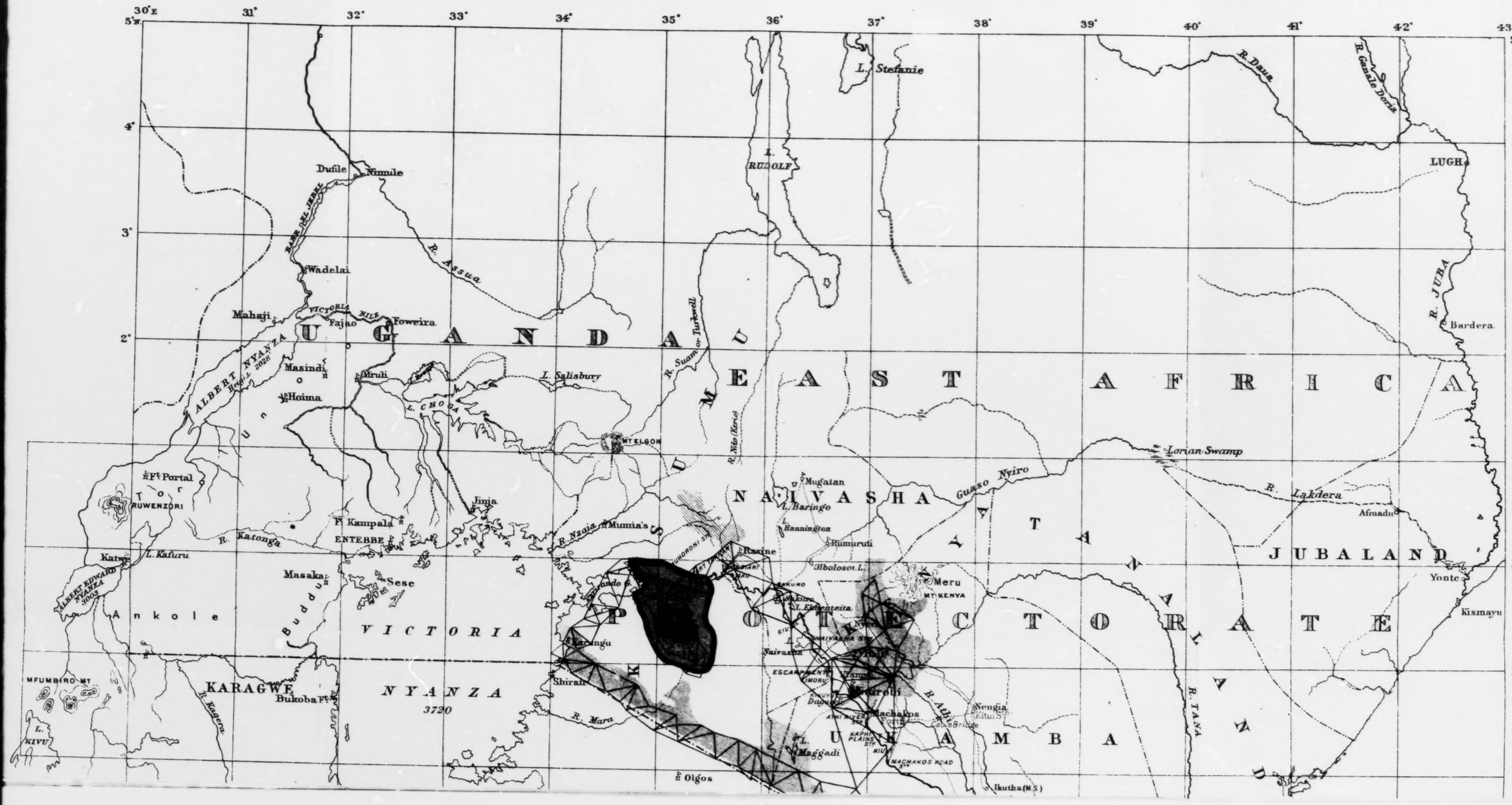






INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA


30° E
31°
32°
33°
34°
35°
36°
37°
38°
39°
40°
41°
42°
43° E
5° N
4°
3°
2°
1°
0°
1°
2°
L. Stefanie
R. Daua
R. Ganale Dorya
L. RUDOLF
LUGH
R. JUBA
Bardera
Dufile
Nimule
R. Assua
Wadelai
Mahaji
Pajao
Foweira
VICTORIA NILE
ALBERT NYANZA
Masindi
Hoima
Miruli
L. Salisbury
L. CHOGA
R. Suam or Turkwell
MT ELGON
R. Nzoia
Mumia's
R. Yala (Kerio)
Lorian Swamp
Guaso Nyiro
R. Lakdera
Afmadu
Mugatan
L. Baringo
L. Hannington
Rumuruti
Ramine
Ilboloso L.
Meru
MT KENYA
L. Elmenteita
Nairobi
Machakos
Nengia
Kitui
L. Maggadi
MACHAKOS ROAD
Ikutha (M.S)
Yonte
Kismayu
R. TANA
R. Athi
Fort Ternan
Kericho
Fort Hall
Nyeri
Fort Hall
Embu
Kitui
Fort Smith
Fort Dalby
Fort Hall
Fort Hall
Fort Hall

EAST AFRICA

UGANDA

GERMAN EAST AFRICA

NYANZA

PROVINCE

KAVIRONDO

NAIVASHA

SOUTHERN GUASO NYIRO PLATEAU

JUBALAND

UKAMBA

COAST

TANA RIVER

SEYIDIE

Lorian Swamp

Albert Nyanza 2020'

Albert Edward Nyanza 3003'

Victoria Nyanza 3720'

Masindi Port

Hoima

Mruli

L. Salisbury

R. Suam

L. Choga

Mt Elgon

R. Nzoia

Mumia's

Jinja

Fort Portal

Ruwenzori

Fort Kampala

Entebbe

R. Katonga

Katwe

L. Kafuru

Masaka

Sese

Buddu

Ankole

Mfumbiro Mt

L. Kivu

R. Kagera

Karagwe

Bukoba Port

R. Mara

Shirati

Muanza

Olgos

Tabora

Ujiji

Kisumu

Kendu

Ravine

Mugatan

L. Baringo

L. Hannington

Rumuruti

Olbolosot L.

Nakuru

L. Elmenteita

Meru

Mt Kenya

Nairobi

Escarpment

Dagoretti

Machakos Port

Athi River

Kapiti Plains

Kiu

Machakos Road

Nengia

Kitui

Cable Bridge

L. Magadi

L. Natron

Mt Kilimanjaro

Kibo R.

Mt Meru

Moshi

Taveta

Voi-Taveta Road

Voi

Jipe

Mwatate

Kibwezi

Ikutha (M.S.)

Tiva R.

Sabaki R.

Malindi

Takaungu

Rabai

Mazeras

Mombasa

Witu

Lamu

Yonte

Afmadu

Kismayu

Wilhemstal

Vanga

Tanga

Pangani

Pemba Id.

REFERENCE

Telegraph lines
Railways
Cart roads
Cleared (Trade) routes
Caravan tracks
Gov^t Stations

Topographical Section, General Staff: N° 2291.(e)

Topography completed in the field

Topography at 1:250,000 published

Triangulation completed

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

Uasin Gishu Plateau Rapid Allotment

Cadastral Surveys completed

Revised June 1908

1° 2° 3° 4° 5°S

30°E 31° 32° 33° 34° 35° 36° 37° 38° 39° 40° 41° 42° 43°E

EAST AFRICA PROTECTORATE.

Governor	Lieutenant-Colonel Sir J. Hayes-Sadler, K.C.M.G., C.B.
Director of Surveys	Major G. E. Smith, R.E.
Deputy Director of Surveys, Trigonometrical Branch.	Captain G. S. Knox, R.E.
Deputy Director of Surveys, Cadastral Branch.	Mr. E. L. Waring.
Assistant Director of Surveys...	Lieutenant E. W. Cox, R.E.

(i.) Staff.

The present staff of the Survey Department consists of :—

Superintending Staff.

Director of Surveys.	1 Clerk.

Trigonometrical Branch.

Deputy Director.	2 Surveyors.
Assistant Director.	Native Artizans.

Cadastral Branch.

Deputy Director.	2 Government Clerks.
Assistant Director.	2 Draughtsmen.
15 Surveyors.	6 Indian Draughtsmen.
2 Clerks.	4 Indian Surveyors.

The Trigonometrical Branch has had the assistance of Captain Stigand and Lieutenant Ward of the 1st King's African Rifles for some months during the year.

(ii.) The Work of the past Year.

Trigonometrical Branch.—Excellent progress has been made during the past year 1907–08. Starting the triangulation from the Athi base, which was completed last year, very rapid progress was ensured from the commencement.

With the longitude obtained by connection with the Anglo-German Boundary Commission's station at Elemobarasha a series was extended as shown on the accompanying diagram.

The Nyeri series covering the most thickly populated uplands is supplemented by a large number of secondary points.

The Lumbwa series follows the Rift Valley northwards to Eldama Ravine station, whence it turns westwards across the railway and joins the Sotik series measured last year. Few secondary points have been established here, as a tertiary triangulation by Mr. Ortlepp covers most of the area, and can be incorporated in the completed work.

Statement of Trigonometrical Work executed in 1906–07 *and* 1907–08.

—	1906–07.	1907–08.
Main Triangulation—		
Area in square miles	1,375	7,320
Mean triangular error	2·39″	2·25″
Probable	1·61″	1·52″
Number of triangles	29	50
Number of stations	23	41
Bases measured	2	0
Latitude observed	2	0
Azimuths „	2	1
Secondary Triangulation—		
Area in square miles	835	3,610
Mean triangular error	4·1″	3·06″
Probable	2·8″	2·06″
Number of triangles	67	163
Number of stations	13	40
Intersected Points—		
Additional area covered, square miles	2,420	5,375
Reconnaissance survey, square miles	2,393	3,350
10 incomplete sheets on $\frac{1}{125000}$.		

In the Nyeri series the probable error in position of the final point is 4·66 feet in direction of the triangulation and 3·10 feet at right angles. For the Lumbwa series the corresponding figures are 6·48 feet and 4·32 feet.

The junction of the Lumbwa series with last year's Sotik series is of considerable interest since it completes a long chain of triangulation. The Anglo-German Boundary series connects Kisumu viâ Karungu and the German Boundary with Elemobarasha. Kisumu and Elemobarasha are now also connected viâ Lumbwa, Nairobi and Athi River.

(1.) The difference in length of the side Chemwibi-Sekauani common to the Sotik series of 1906 and the Lumbwa series 1907 is 0·397 feet in a length of 101,433·39 feet or 1 : 255,000.

(2.) The difference in azimuth between Sotik and the Lumbwa series on the same line is 15·0″.

(3.) The difference in latitude of Chemwibi common to the two series is 2·9″. This is not surprising as considerable local attraction might be expected at Kisumu.

The closing error in longitude on the circuit of 640 miles is $\frac{1}{17700}$. It is probably chiefly due to the earlier less accurate work.

Next year it is proposed to carry a series of large triangles along the line of the railway to the coast near Mombasa. From here it will be extended northwards beyond Malindi. A series along the lower Tana, and a connection with the German Government survey points in Usambara will also require attention.

Topography.—Sanction has now been obtained for the formation of a combined trigonometrical and topographical branch with an increased staff, which will enable the topographic map of the Protectorate to be commenced at once in a methodical and systematic manner.

Cost.—In 1906–7 the Sotik series of triangulation cost Rs. 31·5 per square mile. The triangulation of the Nyeri and Lumbwa series in the past year cost Rs. 10·8 per square mile, and this is expected to be about the average cost of such operations in future.

The topography in 1906–07 cost Rs. 1·1 per square mile. In 1907–08 the cost of the topographic survey was Rs. 1·5 per square mile. The areas surveyed were, however, too small to give a reliable idea of the probable average cost in future.

Cadastral Branch.—The arrears have been reduced to manageable proportions, though the vast areas of farm surveys completely blocked the way to any rapid increase in cadastral maps produced. It is hoped that all arrears will be wiped off during the next six months.

There has been a very marked reduction in the number of new applications for land this year, which may be partly explained by the uncertainty of the position of owners and occupiers while awaiting the publication of a revised Land Ordinance.

A new system of marking farms rapidly on the ground has now been introduced. The rapid settlement of any tract of country can by this means now be guaranteed.

The total staff of the cadastral branch is 32 (exclusive of licensed surveyors) of whom 21 are Europeans and 11 natives of India.

Cadastral maps of Mombasa, Nairobi and Kisumu have been commenced on the $\frac{1}{2500}$ scale. 28 sheets covering an area of 25 square miles have been completed.

Twenty-eight sheets of $\frac{1}{10000}$ series of Sotik and 9 sheets on the $\frac{1}{2500}$ scale of Kericho are in hand.

Provisional maps of Nairobi and Mombasa are already on sale to the public.

Nine hundred and fifty-three square miles of tertiary triangulation with an average triangular error of 7″ were completed during the year.

The following will show the comparative costs of work per acre:—

	Cost per acre. Pence.
1. Sotik Settlement Scheme survey: 100,000 acres at a cost of £2,000 ...	= 4·80
2. Other surveys: 250,793 acres at a cost of £4,700	= 4·50
3. Mean cost of surveys by staff surveyors: total, 350,793 acres at a cost of £6,700	= 4·58
4. Cost of surveys by licensed surveyors: 511,967 acres at a cost of £3,058 ...	= 1·43
5. Mean cost of all surveys: total, 862,760 acres at a cost of £9,758 ...	= 2·71
*6. Supervision charges: total, 862,750 acres at a cost of £1,050	= 0·29

NOTE.—It should be borne in mind that the above costs include that of setting out and parting off land into the various areas required, and not the survey of existing visible boundaries.

The difference of cost between licensed surveyors' work and that of staff surveyors is chiefly due to the fact that all the best class of work, *i.e.*, the survey of open grass lands in large blocks or groups of grazing farms, free of bush or forest cutting, such as the Rift Valley grazing area, goes to licensed surveyors, whilst all isolated and difficult work, and surveys in the lower lying districts and in dense tropical jungle, have to be effected by the Government staff. Further, licensed surveyors refuse to undertake the surveys of small areas at the present schedule rates, saying that they cannot make it pay, nor are they disposed either to work in the Coast or Lake Districts.

In bush or close country the traverses worked are of a rigorous order with a limit of error considerably smaller than the 1 in 2,000 laid down.

The lineal limit of error in standard traverses in townships does not exceed 1 in 10,000.

There are 18 320-acre farms between Lumbwa and Kericho surveyed and ready for allotment, besides 100,000 acres of unoccupied land, which have been surveyed and divided into 5,000-acre units.

* The Director of Surveyors' proportion of superintendence amounts to Rs. 6,934, or £462, and is in addition to Cadastral Branch item 6 in the above statement. This amount added brings the total Supervision charges to 0·42*d.* per acre, or cents 3.

On the Uasin Guishu plateau 107 farms have been set out, and are available for application.

Comparative Annual Statement of Lands Surveyed, April 1st, 1907, to March 31st, 1908.

Year.	Class of Land.						
	Agricultural.	Grazing.	Forest and Rubber.	Fibre and Cotton.	Native Areas, Reserves, Waste Crown Lands and Provisional Surveys.	Residential and Building Plots.	Total.
1904-5	Acres. 49,740	Acres. 526,802	Acres. 10,000	Acres. 32,000	Acres. Details not extracted. Areas included in totals.	Acres.	Acres. 618,542
1905-6	23,277	399,413	220,869	101,974			745,533
1906-7	9,667	519,914	64,320	276,366			870,267
1907-8	16.106	504,737	12,946	188,474*	138,125†	2,372	862,760†

* Includes:—
Fibre concessions, *i.e.*, areas for collection of wild Sanseviera .. 162,042 acres.
Areas for Cotton cultivation .. .. 26,432 „
188,474 „

† N.B.—Total excludes 50,000 acres Uasin Guishu Plateau.

Rapid Allotment.—The system under which land is thus allocated and held is as follows:—

(*a*) Farms are marked off by properly defined, permanent and numbered beacons into approximate areas only.

(*b*) The farms are described by the permanent beacons and not by acreage.

(*c*) The allottee can have his land surveyed by a licensed surveyor or by the Government Survey Department.

(*d*) The rent fixed is subject to re-assessment eventually according to the ascertained acreage, though the acreage is nowhere stated in the occupation deed.

The rapid provisional survey is carried out with plane table at a scale of $\frac{1}{69300}$, or 1·014 inches to 1 mile, based on a minor triangulation, with a triangular error of some 24″. The probable error in the areas so fixed has been estimated to be not greater than 1 per cent., that is to say, it would be extremely unlikely that any area would have an error greater than five per cent.

The farms dealt with on this system average about 3,000 acres. The effect of the system is to ensure that the settler is allotted his farm, with a minimum amount of delay, from a block of farms which have already been marked out. The farms will not require re-marking, and will fall naturally into the Cadastral system which will cover the more valuable parts of the Protectorate. The Committee consider that the method is well suited to meet the demands of any sudden influx of settlers.

Progress.—The progress of the Survey Department of the East Africa Protectorate has been very satisfactory during the year under review.

THE GAMBIA.

The map produced by Major E. L. Cowie, who was in charge of the British party of the Anglo-French Boundary Commission of 1904–05, covers the Colony and Protectorate as far east as 13° 45′ W. It is on the $\frac{1}{250000}$ scale, and is in two sheets. For the present the Gambia has been sufficiently well mapped.

THE GOLD COAST.

Governor ... ... Sir JOHN RODGER, K.C.M.G.
Director of Surveys... ... Major F. G. GUGGISBERG, R.E., C.M.G. (to 3rd January, 1908).
" " " ... ... Captain E. F. W. LEES (from 4th January, 1908).

1. *Completion of Work on the Coast*, 1907.
2. *Mapping Work in England.*
3. *The New Department.*

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1. COMPLETION OF WORK ON THE COAST, 1907.

On June 29th, 1907, the Gold Coast Survey completed six years' work in West Africa and embarked for England. In order to keep the work of the Gold Coast Colony and Ashanti up to date, arrangements were made in the 1908 Estimates for the formation of a small permanent Department which would form a nucleus should the work of demarcating the mining concessions increase at any time.

As the new department was not to start work until 1908, all stores were handed over to the Director of Works before embarkation, and arrangements were made for employment under him of the native staff.

On the voyage home 2nd Corporal E. J. Strickland, R.E., died of blackwater fever. 2nd Corporal J. W. Walsh was left in hospital at Accra with the same sickness, from which he ultimately recovered.

2. MAPPING WORK IN ENGLAND.

Offices were opened at 198, Clarence Gate Gardens immediately on landing in England and the work of producing the sheets of the $\frac{1}{125000}$ map were taken in hand. No interruption in this work occurred, as had been the case in previous years, owing to constant embarkations, and by 21st May more than

three-fourths of the sheets were published, and the fair drafts of the remainder all in Messrs. W. & A. K. Johnston's hands.

A school wall map of the Gold Coast, Ashanti, and the Northern Territories was compiled and placed in Messrs. Johnston's hands for production.

The $\frac{1}{1000000}$ map was slightly revised and printed for inclusion in the Gold Coast Civil List. Extensive alterations are now required to bring this map up to date.

The $\frac{1}{250000}$ sheets were corrected for the Topographical Section of the General Staff from the $\frac{1}{125000}$ sheets.

An index of the $\frac{1}{125000}$ sheets was prepared, a laborious but necessary piece of work, by Captain C. F. Sewell, late 60th Rifles, formerly Transport Officer of the Gold Coast Survey.

Captain C. B. O. Symons, R.E., reverted to regimental duty in November, 1907, after two years' valuable service with the survey. After resigning the appointment of Director of Surveys to Captain E. F. W. Lees, R.E., in January, Major Guggisberg remained on special employment under the Colonial Office to finish the map.

3. The New Department.

On 4th January, 1908, Captain E. F. W. Lees, R.E., took over the directorship of the survey and embarked for West Africa accompanied by Corporals G. V. Mathieson, R.E., (Chief Surveyor) and R. N. Kilby, R.E. (Surveyor).

On landing at Sekondi the two last named proceeded immediately to the Ofin and Prah rivers to cut the boundaries of mining concessions and are still employed on this work. At Accra, however, Captain Lee's work in the field was brought to a standstill by the presence of plague.

4. Ashanti.

The mapping of Ashanti is now in the hands of Lieut. E. V. M. Shelley, the Intelligence Officer. It is hoped that eight sheets on the $\frac{1}{250000}$ scale will be published by the end of the year.

5. Summary of Six Years' Work.

The total expenditure on the Survey Department from June, 1901, to January, 1908, amounts to £127,500; of this £44,000 was recovered in survey fees. The average net annual expenditure was thus about £13,000.

For this sum all the gold mining concessions have been marked out and surveyed, the whole of the Gold Coast and part of Ashanti have been covered with a network of rigorous traverses, and the same area has been topographically mapped, the horizontal framework of the map being very complete. The map covers an area of about 36,000 square miles, and may be

said to represent a by-product of the main work of the Department. The Committee desire to bring to notice the excellent work of Major Guggisberg, and of those who served under him.

NORTHERN NIGERIA.

Governor	...	Colonel Sir PERCY GIROUARD, K.C.M.G., D.S.O., R.E.
Intelligence Officer	...	Captain H. N. KEMPTHORNE.

The state of the Mapping of Northern Nigeria is as follows :—

The sheets of the $\frac{1}{250000}$ series of the topographical section of the General Staff cover Northern Nigeria, but these sheets are now considerably out of date, and do not include the work of the recent Anglo-French Commission along the northern frontier, nor the work of the Anglo-German Commission south-westward of Yola, and are not based, as regards the centre of the country, on the results of Captain Ommanney's longitude expedition, which fixed 13 important towns and very materially altered their positions. The existing series may, in fact, be considered obsolete.

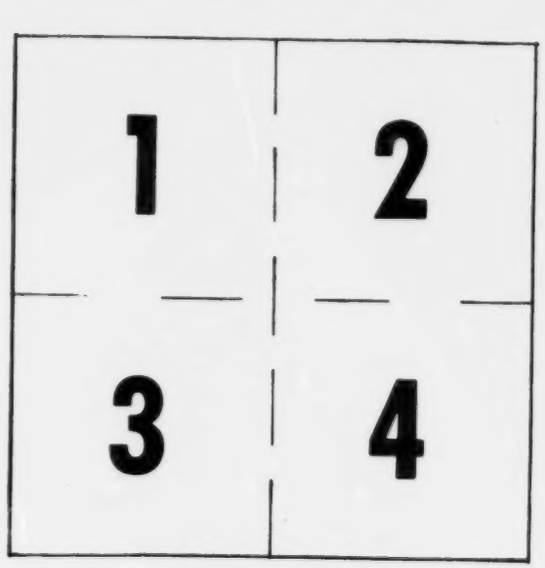
It will be seen that the major geographical framework is very complete. Unfortunately the state of the finances of the Protectorate do not admit of the expenditure of the sum necessary for carrying out a systematic geographical survey based on this framework.

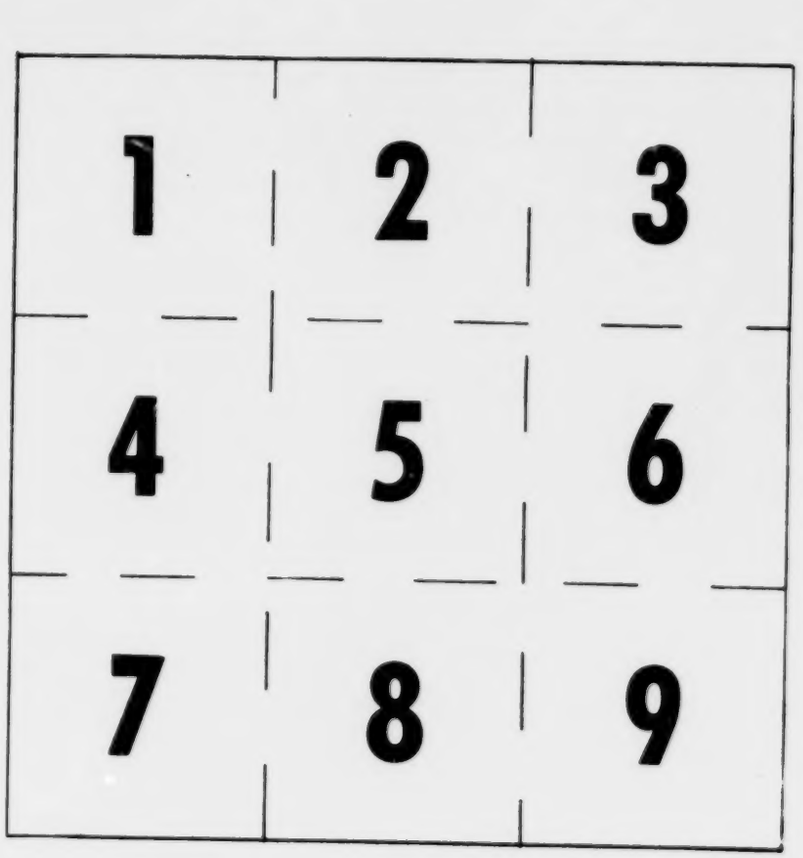
A consideration which must be taken into account is, that experience demonstrates the fact that for a geographical compilation to be of value it should be carried out by those who know the country, have lived there, and are acquainted with the work of the travellers whose sketches and surveys are to be employed. The compilation should also, whenever possible, be made in the country itself.

It has, therefore, been decided that in future the compilation of the maps of Northern Nigeria shall be entrusted to the Intelligence Officer in Northern Nigeria, who will take as fixed points all places determined by Boundary Commissions, and those determined by Captain Ommanney.

The Intelligence Office, which now consists of one officer and one native draughtsman, will be strengthened by the addition of one British non-commissioned officer, and also it is hoped by the loan of the services of an officer of the West African Field Force for 10 months in the year. It has been decided that the scale of the compilation shall be $\frac{1}{250000}$, but as the area of the Protectorate is 256,000 square miles, and as 50 sheets are required to cover this area, it is evident that, as regards maps, Northern Nigeria will be at a disadvantage as compared with the other colonies and protectorates of British Tropical Africa for many years to come.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





10°

Ilella
Busa
Tchara
Matankari
Konni
Dantudu
Kania
L. CHAD
Daura
Maikouri
Beibei
Sokoto
Katsena
Jungu
Argungu
Birnin Kuka
Dumjiri
Kukuwa
Hadeija
Yelwa
Katagum
Kano
Maifoni
R. NIGER
Zaria
Yelwa
NORTHERN NIGERIA
Leri
Kontagora
Bussa
Bauchi
N. 10°
10°N.
Zungeru
Bida
Jebba
Keffi
Patigi
Amar
Yola
Ilorin
Ibi
Loko
Lokoja
R. Benue
Ibadan
SOUTHERN NIGERIA
LAGOS
Benin
Calabar
(By chronometer journeys)
5°
5°
Telegraphs used in determining positions shewn.
Akassa
5° E.
10°

DIAGRAM OF POSITIONS IN NIGERIA

fixed both in latitude & longitude.

Scale 6,000,000 or 1·014 Inches to 96 Miles.

Miles 50 0 50 100 150 200 Miles

LONG: BY TELEGRAPH ⊠
" " ABSOLUTE METHODS Φ

LIST OF POSITIONS.

	Latitude.	Longitude.		Latitude.	Longitude.
Argungu	12 44 35 N.	4 30 20 E.	Kontagora	10 23 24 N.	5 30 29·16 E.
Beneki	10 18 24·06 N.	9 48 37·45 E.	Kubawa	13 35 13·6 N.	13 34 41·1 E.
Bida	9 5 44 N.	5 54 29·5 E.	Leri	10 32 10·06 N.	9 34 12·00 E.
Birnin Kuka	13 37 01 N.	9 30 20 E.	Lokoja	7 50 51·5 N.	7 48 51·23 E.
Bussa	10 35 34 N.	4 34 39·5 E.	Maikouri	13 13 43·75 N.	8 37 00·45 E.
Dumjiri	13 40 37 N.	7 34 39·1 E.	Matankari	13 45 41·7 N.	3 30 25·5 E.
Ilorin	13 30 16 N.	5 24 16 E.	Calabar (Garden House)	4 57 36 N.	8 19 05 E.
Ilella	7 33 10·41 N.	5 33 41·06 E.	Patigi	8 44 5·76 N.	5 45 30·05 E.
Ibi	8 10 45·76 N.	9 44 10·62 E.	Sokoto		5 14 41·7 E.
Illorin	14 37 47·6 N.	5 15 37 E.	(Residency)	13 00 10 N.	5 14 40·9 E.
Jebba	8 30 20·77 N.	4 34 53·90 E.	Tchara	14 04 06 N.	6 06 42 E.
Jungu	9 07 44·06 N.	4 40 05·25 E.	Yelwa	13 15 37 N.	3 34 35 E.
Kano	13 27 30 N.	8 31 40·4 E.	Yelwa	10 31 03 N.	4 44 10·43 E.
Kania	13 48 49·21 N.	11 10 34·9 E.	Yola	9 13 30·9 N.	12 30 30 E.
Kubawa	13 00 13·76 N.	7 41 40 E.	Zaria	11 06 10·06 N.	7 42 37·44 E.
Keffi	8 20 34·20 N.	7 51 54·46 E.	Zungeru	9 48 39·4 N.	6 08 43·06 E.
Kontagora	10 47 37 N.	5 16 48 E.			

LAGOS (Observatory) { Lat: 6° 26' 38·6 N, Long. 3 23 49·83 E. } Fundamental value (telegraph) from Cape Observatory.

T.S., G.S., Nº 2288.

Printed at the Ordnance Survey Office Southampton. 1908.

Telegraphic Longitudes.

Summary of Results.

Place.	Latitude, N.	Longitude, E.	Height above M.S.L.
	° ′ ″	° ′ ″	
Bauchi	10 18 54·66	9 49 27·55	2,260 feet.
Ibi	8 10 45·76	9 44 10·83	580 „
Jebba	9 07 44·92	4 49 02·25	430 „
Kano	12 00 12·00	8 32 42·29	
Keffi	8 50 34·29	7 51 54·48	1,290 feet.
Kontagora	10 23 34·00	5 29 22·16	
Leri	10 23 16·26	8 34 19·00	2,670 feet.
Loko	7 59 51·5	7 49 51·23	350 „
Lokoja	7 48 01·2	6 44 22·95	320 „
Patigi	8 44 05·76	5 45 28·05	490 „
Yelwa	10 51 03·00	4 44 10·43	
Zaria	11 06 10·38	7 42 57·44	2,230 feet.
Zungeru	9 48 32·4	6 09 42·26	530 „

The above longitudes were all determined telegraphically.

The heights are arrived at by combining hypsometer observations at each station with relative values obtained by readings of aneroid barometers.

List of Reliable Determinations of Longitude in and near Nigeria (other than Telegraphic).

Place.	Latitude, N.	Longitude, E.	Remarks. Determination of Position and place of Observation.
	° ′ ″	° ′ ″	
Argungu ...	12 44 35	4 30 29	3 occultations. S.E. gate.
Beibei* ...	12 52 44	3 54 19·5	Edge of cliff 1,000 yards S. of town.
Birnin Kuka	12 27 01	3 58 39	2 occultations. East gate.
Busa	14 25 24	6 04 28·5	2 occultations. Camp N. of French post.
Dantudu ...	13 40 27	7 04 38·1	1 occultation.
Daura ...	13 02 16	8 24 16	1 occultation and watches from Katsena. Camp East gate of town.

* These places are connected by a line of latitudes and azimuths

Place.	Latitude, N.			Longitude, E.			Remarks. Determination of Position and place of Observation.
	°	′	″	°	′	″	
Ilella	14	27	47·6	5	15	27	3 occultations. Anglo-French camp.
Junju* ...	12	37	20	3	31	49·4	Hill N.E. of town.
Kania ...	13	48	42·21	11	10	24·9	2 occultations.
Katsena ...	13	00	12·74	7	41	40	1 occultation. Residency.
Konni ...	13	47	37	5	15	48	Latitude and azimuth from Ilella. N.W. corner of town.
Kukuwa ...	12	55	13·8	13	34	41·1	2 occultations. Centre of town agreed on by Commission.
Maikouri ...	13	13	43·75	8	57	06·45	3 occultations.
Matankari* ...	13	45	41·7	3	59	25·5	Big tree near A.–F. camp.
Sokoto (Residency).	13	02	10	5	14	41·7	12 occultations.
				5	14	46·9	Anglo-French Boundary Commission.
Chara ...	14	04	08	6	02	42	By watches from Busa. N.W. corner of town.
Yellu	12	15	37	3	34	35	Captain Lang, R.E. N.W. corner of town.
Yola	9	12	28·9	12	29	30	Mean of German and British occultations.

* These places are connected by a line of latitudes and azimuths.

NYASALAND.

No survey work of any importance has been carried out in this Protectorate during 1907–08. A list of the maps on sale to the public will be found in the catalogue published by the Topographical Section of the General Staff.

RHODESIA.

Sketch of the State of the Surveys.

The geodetic chain extends throughout Rhodesia to a point about 50 miles south of Lake Tanganyika. There is, however, practically no secondary or minor triangulation in Southern Rhodesia.

No organised topographical survey has yet been commenced.

The farm surveys in Southern Rhodesia vary in accuracy from compass surveys to the usual accurate cadastral plans carried out with chain and theodolite.

The farm surveys in North-Eastern Rhodesia are carried out by surveyors (nominated by the Administrator), by trigonometric methods. Surveys of large properties by chain, stadiometer, tacheometer, or compass are not permitted to be used for the issue of the final title.

In North-Western Rhodesia an area of 15 miles round the Victoria Falls has been surveyed.

Compilations.

The Surveyor-General of Southern Rhodesia is undertaking the compilation, from farm plans and other sources, of a general map of Southern Rhodesia. This map will be published on a scale of $\frac{1}{250000}$. Some sheets of this series have been sent home and are now being reproduced.

SIERRA LEONE.

Governor ... ... Leslie Probyn, Esq., C.M.G.
General Officer Commanding... Major-General J. K. Trotter, C.B., C.M.G.

There is no survey department.

The General Officer Commanding is causing a survey to be carried out of that portion of the Colony adjacent to Freetown. The results of the survey are being embodied in the existing sheets of the $\frac{1}{250000}$ series, which will be greatly improved in consequence. For a list of the published maps of Sierra Leone the catalogue published by the Topographical Section of the General Staff should be consulted.

SOUTH AFRICA.

General Review of the Surveys.

The Survey Departments.—The Colonial Survey Committee is not concerned with the surveys of the South Africa Colonies, except in so far as Imperial interests are involved. Each Colony has a Survey Department administered by a Surveyor-General,

These Surveys Departments, are in effect, land record departments. The farms are surveyed by licensed surveyors and plans and records of the farms are left in the Surveyor-General's office. For purposes of land registration the system is an efficient one. The farm plans as a rule show only what is necessary for the definition of property boundaries; each farm is surveyed independently, and from the nature of the case little attention is paid to the delineation of the hill features.

The Geodetic Triangulation.—*See* p. 42.

Imperial requirements.—The chief Imperial requirement is the provision of topographical maps for the defence of the Colonies. The matter has not been directly before the Colonial Survey Committee; the information which follows having been furnished by the War Office.

State of the Topographical Maps of South Africa.—The production of topographical maps is proceeding in the Cape Colony and in the Orange River Colony. A sketch of Basutoland is being carried out and now approaches completion.

The total area completed in the field in the Cape Colony, the Orange River Colony and Basutoland amounts to about 90,000 square miles.

No topographical maps exist of Natal or of the Transvaal, and no such maps are being produced.

Compilation Maps are those fitted together from farm surveys. Of this nature are the Cape Colony district maps and the "Degree Sheets" of the Transvaal on the scale of 2·37 miles to 1 inch, produced during the War under the superintendence of Colonel H. M. Jackson, A.A.G. for Topography. The Degree Sheets of the Transvaal are still the only general maps of that Colony available; they serve to give farm names, but are misleading as regards hill features.

THE CAPE COLONY.

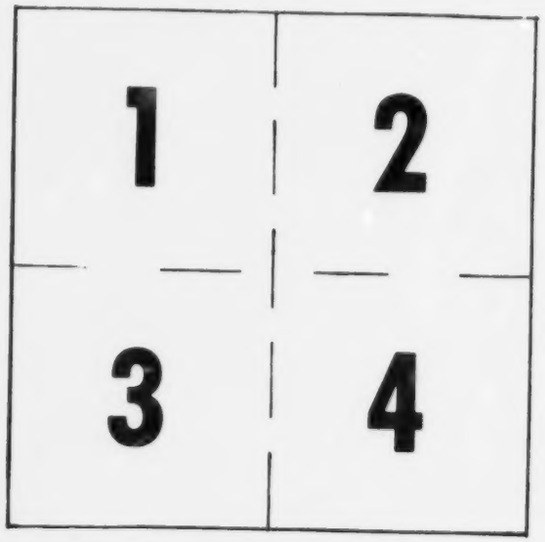
Progress.—The work of the reconnaissance surveys has made steady progress during the past year.

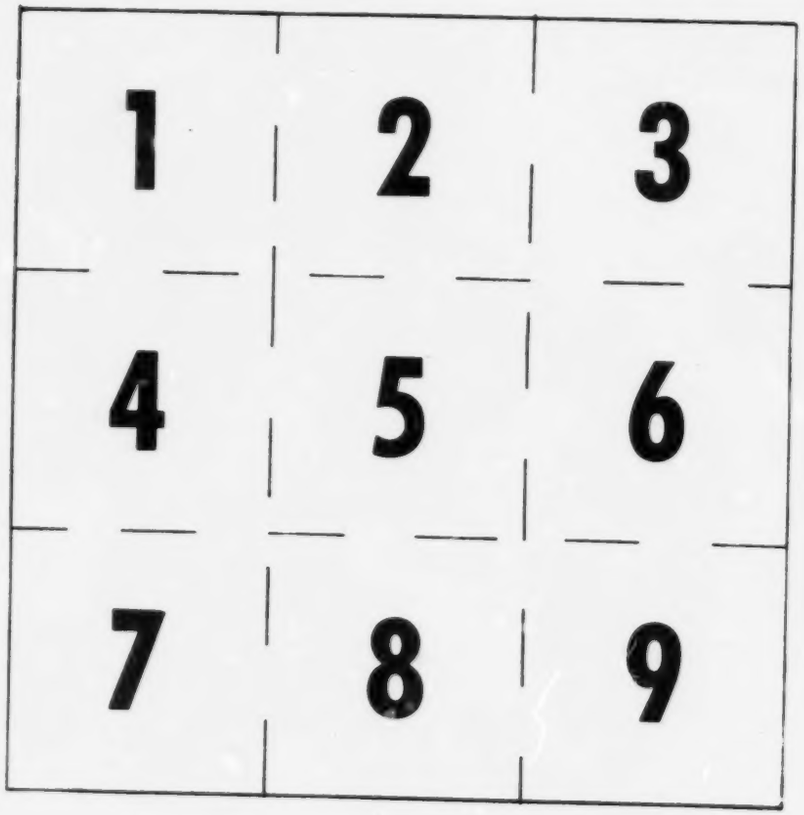
Since 31st March, 1907, an area of 17,000 square miles has been completed in the field, bringing the total area surveyed since the commencement of the reconnaissance work up to 58,000 square miles.

Of the above, seven sheets, on a scale of $\frac{1}{250000}$, representing an area of 19,000 square miles, have now been published.

Six parties, each consisting of one seconded and one temporarily attached officer, and the necessary transport, were

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





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on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

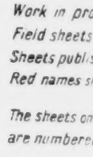
Scale $\frac{1}{4,000,000}$

Miles 50 0 50 100 150 200 Miles

REFERENCE

Work in progress.....
Field sheets completed.....
Sheets published.....
Red names shew names of sheets

The sheets on the scale of 1/125,000 are numbered thus 129-B-III



16° 17° 18° 19° 20° 21° 22° 23°
22° 23° 24° 25° 26° 27° 28° 29° 30°
25° 26° 27° 28° 29° 30°

GERMAN SOUTH WEST AFRICA

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TRANSVAAL

BASUTOLAND

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R. Bushman
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R. Orange
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R. Modder
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Umzimkulu
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Umtamvuna
Kokstad
Matatiele
Mount Fletcher
Maclear
Barkly East
Rouxville
Smithfield
Zastron
Wepener
Ficksburg
Clocolan
Ladybrand
Thaba Bosigo
Bethulie
Aliwal North
Dordrecht
Indwe
Lady Frere
Cala
Queenstown
Komgha
Butterworth
Idutywa
Kentani
Elliotdale
Umtata
Kokstad
Matatiele
Mount Fletcher
Maclear
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50 100 150 200 Miles

REFERENCE

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eets published

f names shew names of sheets

sheets on the scale of 1/125,000 numbered thus 129 - B - III

BECHUANALAND WEST

ORANGE RIVER COLONY

TRANSVAAL

BASUTOLAND

SWAZILAND

NATAL

EASTERN PORTUGUESE AFRICA

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Mzimkulu R.

Umzimvubu R.

Umtata

Kokstad

Matatiele

Mount Ayliff

Mount Frere

Port St Johns

Umtata

Kei Mouth

Butterworth

Idutywa

Willowvale

Elliotdale

Lusikisiki

Port Grosvenor

Port Shepstone

Umzinto

Port Edward

Scottburgh

Amanzimtoti

Isipingo

Port Natal

Durban

Pinetown

Verulam

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Sand R.

Letaba R.

Olifants R.

Crocodile R.

Elands R.

Pienaars R.

Kaapmuiden

Komati R.

Lourenço Marques

Usutu River Mouth

Swaziland

Zululand

Basutoland

Transvaal

Orange River Colony

Bechuanaland West

Eastern Portuguese Africa

Natal

19° 20° 21° 22° 23° 25° 26° 27° 28° 29° 30° 31° 32° 33°

22° 23° 24° 25° 26° 27° 28° 29°

T.S.G.S., Nº 2214.3

Compiled in the Topographical Section, General Staff.

1906

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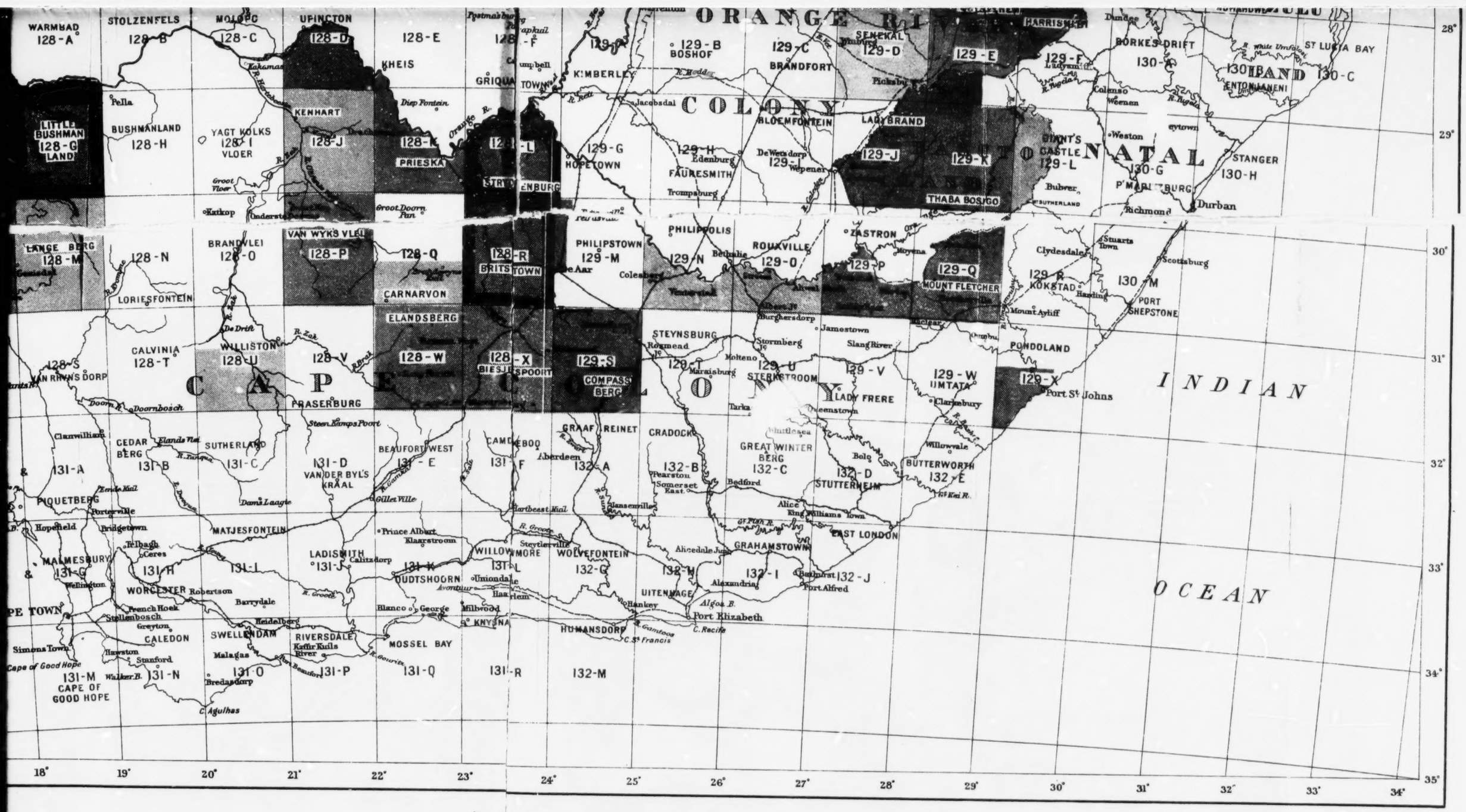

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1906

War Office, Revised June 1908.

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employed in the field up to the beginning of November, after which date the parties were reduced to three. The seconded officers employed during the past year were—

Captain H. S. P. SIMON, D.C.L.I.
" C. W. GORDON, North. Fusiliers.
" A. B. JOHNSON, Linc. Regt.
" R. B. HOPKINS, Manch. Regt.
" T. S. N. HARDINGE, R.G.A.
Lieut. R. A. REDDIE, 16th Lancers.

The work was in charge of Captain C. G. W. Hunter, R.E., up to March last, and is now in charge of Captain G. F. Evans, R.E.

In the two years during which Captain Hunter had charge the reconnaissance surveys have been thoroughly well organized, and excellent progress has been made.

THE ORANGE RIVER COLONY.

The Topographical Survey of the Orange River Colony which is being carried out by the Colonial Survey Section under the command of Captain L. C. Jackson, R.E., has made excellent progress during the past year.

Since the 1st June, 1907, an area of 7,300 square miles has been completed in the field, bringing the total area surveyed in detail in the field to 19,448 square miles.

The whole of this detailed work is based upon a secondary triangulation extended from the primary geodetic triangulation.

The average daily output of the Section since the commencement of the survey has been 21·62 square miles.

The mean triangular error during the year was 2·6″.

The closing errors in a chain of secondary triangulation 100 miles in length were 0·030″ in latitude and 0·020″ in longitude.

The Section is now employed in the very broken country along the Basutoland border, between Ficksburg and Harrismith.

Here roads are few and difficult, and in many parts quite impassable for wheeled transport. The prevalence of fog and mist on the high ground also adds greatly to the difficulties of the survey.

Captain Jackson will complete his tenure of appointment in August of the present year. He will have carried out the topographical survey of nearly half the Colony. Great credit is due to this officer for the ability and energy with which this important survey has been conducted, and for the rapidity and accuracy of its execution.

SOUTHERN NIGERIA.

Governor	... ...	Sir WALTER EGERTON, K.C.M.G.
Director of Surveys	... ...	Mr. E. P. COTTON.

(i.) STAFF.

The Department consists of :—

The Director of Surveys.
6 European Surveyors.
6 Native Surveyors and Draughtsmen.
4 Native Students.

(ii.) COST OF THE DEPARTMENT.

The estimated expenditure of the Survey Department for 1908 is £10,359, and of the Land Office £6,088.

(iii.) MAPS ISSUED DURING THE PAST YEAR.

Five provisional skeleton maps on the scale of $\frac{1}{253000}$ have been published by reduction. These maps cover most of the Western Province, and embrace an area of about 20,000 square miles. They exhibit all the traverses carried out by the Survey Department, and are, in fact, the framework upon which the complete topographical map of the Western Province will be based. Detailed instructions as to the preparation of the final maps have been issued. If these maps, which will be on the scale of $\frac{1}{125000}$, are found to be satisfactory, it will be desirable to continue the present rate of expenditure on surveys so as to complete the topographical survey of the whole of Southern Nigeria. With the present staff the average out-turn per annum should be about 8,000 square miles.

UGANDA.

Governor	... ...	Sir H. HESKETH BELL, K.C.M.G.
Director of Surveys	...	Mr. R. C. ALLEN.

(i.) DUTIES OF THE SURVEY DEPARTMENT.

The Survey Department is, at present, charged with the following duties :—

(*a*) The execution of cadastral plans of Buganda (the new name for the Province of Uganda).

(*b*) The production of a topographical map of Buganda on a scale of $\frac{1}{125000}$.

(*c*) Miscellaneous surveys for engineering purposes.

It is in contemplation to relieve the Survey Department of duties (*b*) and (*c*), in order that it may devote itself entirely to the execution of cadastral plans, which are required for the allotment of estates to chiefs and native landowners in accordance with the Uganda Agreement of 1900. The rate of progress of the cadastral survey has been slower than was anticipated, partly on account of the necessity of providing surveyors for miscellaneous duties. The cost of the Land and Survey Department for 1907–08 was £5,561.

(ii.) The Work of the Survey Department.

An area of 1,900 square miles has been covered with the main triangulation during the past year, the mean triangular error being 4·5″. It will not be necessary to undertake any more triangulation of this character for some years.

Secondary triangulation, covering an area of 607 square miles, has been completed in the field. Mean triangular error 5·4″.

The total area of topographical survey on the scale of $\frac{1}{125000}$ carried out during the past year was 1,575 square miles, a satisfactory output for two surveyors.

Two hundred and seventy-eight square miles of detailed cadastral survey on the scale of $\frac{1}{10000}$ were completed, and 15 square miles on the scale of $\frac{1}{2500}$. A considerable number of miscellaneous surveys were carried out.

The Committee consider that the Survey Department under Mr. Allen has done good work during the year under review. There can be little doubt that it will be sound policy to concentrate the energies of the Department on the Cadastral Survey.

Note.—The above paragraphs refer to the work carried out for the year ending 31st March, 1908.

The field sheets of two of the $\frac{1}{125000}$ maps have been received, and are now being reproduced. These sheets are 86 U.I. and 86 U. III., covering an area of 2,500 square miles.

(iii.) Uganda Railway Extension Survey.

Important topographical surveys which have been carried out during the year under review are those which have been executed independently of the Survey Department, as part of the work of the Uganda Railway Extension Survey which is being carried out under Captain A. G. Stevenson, D.S.O., R.E.

Lieut. C. E. Fishbourne, R.E., assisted by two non-commissioned officers, has been engaged in mapping the region between Lake Victoria and the north of Lake Choga. The progress of the work and its accuracy are both very satisfactory. Three field sheets have so far been completed, covering an area of 2,500 square miles.

(iv.) Surveys of the South, South-West and East Shores of Lake Albert.

As an addition to the work of surveying the Anglo-Congolese boundary zone to the west of Uganda, Lieut.-Colonel R. Bright, C.M.G., has been engaged in surveying the south, south-west and east shores of Lake Albert. This survey will be valuable, not only for the consideration of boundary questions, but also in the discussion of schemes of railway extension. The field sheets cover an area of about 9,000 square miles. They will form an important contribution to our knowledge of the geography of Uganda.

(v.) Summary.

The Survey Department has topographically surveyed 1,575 square miles, and has been pursuing its laborious task of mapping the Buganda estates; the Anglo-Congolese Boundary Commission has completed the mapping of the boundary zone, and has surveyed 9,000 square miles of that region; the Railway Extension Survey has surveyed lines for the continuation of the Uganda Railway, and has also mapped 2,500 square miles of the Lake Choga region; and finally Commander Whitehouse's map of Lake Victoria has been plotted and adjusted to the Anglo-German Commission maps, with which it is in excellent agreement. All this work is based on sound triangulation, and it may be said that greater progress has been made in surveying Uganda during the past year than in any previous year.

V.

REPORT ON THE SURVEYS

OF

CEYLON and the FEDERATED MALAY STATES.

CEYLON.

Governor ... ... Col. Sir H. E. McCALLUM, R.E., G.C.M.G., A.D.C.

Surveyor-General ... ... P. D. WARREN, Esq., C.M.G.

(i.) *Historical Sketch.*
(ii.) *Existing State of the Surveys.*
(iii.) *Existing State of the Maps.*
(iv.) *Organization.*
(v.) *Inspection of the Department.*

(i.) HISTORICAL SKETCH.

Up to the year 1897 the Ceylon Survey Department worked upon the so-called "Application" system, viz., the system of surveying isolated patches of land, as required for Land Office purposes, without any general scheme of work, and for the most part unconnected with any system of triangulation. The cost of the work was enormous and its accuracy questionable. No sort of topographical survey had been attempted, and the only map of the island existing in 1897 was one chiefly based upon a sketch map made by Colonel Fraser in the early part of the nineteenth century.

The result of this system, or rather want of system, was not only that the cost of so-called survey was enormous and the resulting maps almost valueless, but also, owing to the absence of any cadastral maps, the "Crown lands and forests were being eaten away and devastated by encroachment, and were slowly but surely disappearing."*

It was realised that this state of affairs was highly unsatisfactory, not, however, it may be noted, until vast sums had been wasted, and Colonel T. H. Holdich, R.E., of the Survey Department of India was invited to visit Ceylon and report on the whole subject. His report contained many valuable suggestions,

* Sir J. West Ridgeway to Colonial Office, 1st June, 1897.

some of which were acted upon. He recommended that the triangulation should be improved and re-computed—that a systematic topographical survey, upon the Indian model, should be at once initiated—that the cadastral work should be taken up systematically in blocks—that the Indian practice of dividing the year's work into a definite field season and a recess should be adopted—and that certain reductions should be made in the higher grades of the Department.

In 1898 the first "Waste Lands Ordinance," providing for the definitive and final delimitation of the boundaries of Crown lands and the prevention of further encroachments, was passed. This measure compelled the provision of an accurate land map for each village as its turn came to be "settled" under the Ordinance. The "Block" survey system was accordingly started. The term block survey is peculiar to Ceylon and requires definition; it is a survey which delimits the boundaries between cultivated and uncultivated land, but does not concern itself with boundaries or features inside an area of cultivation. It is thus designed to meet the special requirements of the Waste Lands Ordinance. It is not a cadastral survey in the usual meaning of the term, but if executed systematically and accurately it is capable of conversion into a cadastral survey at no very great expenditure. Unfortunately, during several years this work was executed upon unsystematic and inaccurate methods, and it was not until 1905, when the 4 chains to 1 inch block survey was started, that any work of a really permanent nature was done.

(ii.) Existing State of the Surveys.

The triangulation of Ceylon is connected with the Indian series by means of the measured base on the island of Delft, off the north-western coast. The differences of longitude between Madras and Colombo and Madras and Jaffna have been determined by the Indian Survey. The astronomical latitude of Colombo has a residual uncertainty of about 3 seconds of arc and is now being re-observed. The principal triangulation over the island is of a fair order of accuracy; there still remains to be done a large quantity of secondary and tertiary triangulation. Owing to the "hand to mouth" system of work vast numbers of points have been observed and lost again through not being properly marked, or through the observations not being systematically recorded.

Block survey is in progress at many points in the island.

A sort of topographical survey has been prosecuted since Colonel Holdich's visit, but it was started on methods contrary to all his recommendations, with the result that 10 years' work has been practically wasted. At the present moment there is no topographical map in the usual acceptance of the term, of any part of the island, except a small area done for railway extension purposes.

(iii.) Existing State of the Maps.

None of the block survey work is published, except in the form of village plans for settlement purposes. As no topographical survey exists the general maps of the island are compilations from material of varying order of merit; of these the following have been published by the Department :—

Map of the Island of Ceylon—

4 miles to 1 inch	...	...	...	1876
4 „ 1 „	...	...	...	1881
4 „ 1 „	...	...	...	1900
4 „ 1 „	...	...	...	1907
8 „ 1 „	...	...	...	1900
12 „ 1 „	...	...	...	1906
16 „ 1 „	...	...	...	1906

Topographical survey (in progress)—

1 mile to 1 inch. 73 sheets issued up to December, 1907.

(This, as stated above, is not correctly described as a topographical map. It contains, for instance, no representation of the shape of the ground.)

Various plans of towns and municipal districts —

Kandy, Trincomalee, Colombo, Galle, Diyatalawa.

(iv.) Organization.

The Survey Department is a branch of the Civil Service, all the higher posts being permanent and pensionable. No officers are employed in it. The field surveyors are all natives of Ceylon.

(v.) Inspection of the Departments.

In Colonel Holdich's report he made a recommendation, which was accepted and acted upon, for a gradual reduction in the numbers and final extinction of the rank of Assistant Superintendent of Surveys. The abolition of this grade seriously embarrassed the Department, and as the Waste Lands Ordinance and the agricultural development of the island, largely in the direction of rubber planting, had so changed the conditions since Colonel Holdich's visit, it was judged advisable to make another independent inspection.

The Secretary of State for the Colonies accordingly deputed Major E. H. Hills, C.M.G., R.E., to inspect and report. Major Hills arrived in the island on 26th April, 1907, and submitted a report dated 6th June, 1907.

In this report it was pointed out that the changed condition of affairs necessitated a reversal of the policy of extinction of the grade of Assistant Superintendent. The fact that Sir T. Holdich's recommendations, as regards the topographical survey,

had been so entirely set aside was commented upon, and a new series of recommendations, for the accomplishment of this important work, were formulated. Suggestions were made as to improvements in the system of discipline of the native staff, for the completion of the tertiary triangulation and for the prosecution of lines of levelling, and for various improvements in method for the block survey and cadastral work. It was also pointed out that there was still substantial danger of waste and inaccuracy, owing to small incomplete parties being at work; and the general lines of a possible enlargement of the department was foreshadowed in the event of the Government deciding to hasten the waste lands settlement.

The great improvement in accuracy and the marked diminution in cost rates that had taken place during the latter few years was favourably noticed.

All Major Hills's recommendations were approved by the Colonial Survey Committee and were accepted by the Governor and the Secretary of State for the Colonies. It is hoped that they will all be given effect to by the end of 1908.

FEDERATED MALAY STATES.

Resident-General ... ... Sir W. T. Taylor, K.C.M.G.

(i.) *Historical Sketch.*
(ii.) *Existing State of the Surveys.*
(iii.) *Existing State of the Maps.*
(iv.) *Organisation.*
(v.) *Inspection of the Department.*

(i.) Historical Sketch.

In the early days of the Protectorate the survey of Perak formed part of the Public Works Department.

In 1883 Mr. H. J. Deane, a contract surveyor in Ceylon, was engaged to visit the State and report. Mr. Deane toured the country, ascending several of the most lofty peaks, and made sufficient observations to compile the existing material into the first map of Perak on the scale of 4 miles to 1 inch.

As the result of his report Mr. Deane's services were engaged to carry out the triangulation of Perak. He measured the Larut base, about 4½ miles, with deal rods, working almost single-handed, and started a series of triangles, observing the angles with an 8-inch vernier theodolite by Elliott.

By 1887 this triangulation extended over the districts of Larut and Kuala Kangsar.

Mr. G. A. Lefroy was then placed in charge of the Department as Chief Surveyor, and it was separated from the Public Works. Shortly after this the nucleus of the present Perak Land and Revenue Survey Department was formed under the Commissioner of Lands.

Mr. Lefroy re-measured the Larut base, and in 1892, when Mr. A. E. Young, the present Chief Surveyor, joined the service, had extended the triangulation over about half the State. In 1893 it was decided to re-observe the angles at all major stations with 8-inch micrometer theodolites, a work which was mainly entrusted to Mr. F. W. Irby.

By the end of 1895 this had been almost completed up to the Selangor boundary, where it had been arranged to close on a check base, when owing to Mr. Lefroy's retirement all field operations were stopped. Work was not resumed until the end of 1896 when, on the retirement of Mr. F. W. Mais, the acting Chief Surveyor, Mr. A. E. Young, was appointed officer-in-charge. The task of reducing the whole triangulation by least squares and co-ordinating all the minor work and standard traverses, a large quantity of which had been undertaken to meet urgent Land Office requirements, was at once initiated. This was completed in 1898.

In 1896 Colonel W. G. Morris, R.E., was invited to make a report on the Perak survey. He accordingly did so, and his report contained many valuable suggestions. He had, however, no knowledge of the country, and only access to a portion of the survey records. It was suggested by him that the only satisfactory procedure would be for a competent officer to proceed to the country and draw up a complete report and programme for future work. It is somewhat unfortunate that the proposal was not acted upon.

In 1899 Mr. Young was made Chief Surveyor, and was ordered to continue the triangulation through Selangor and Negri Sembilan. By 1901 this work had been completed over the whole of Selangor and closed on the check base. In this year the services of the most competent surveyors were lost so that the triangulation was not finally extended over the small State of Negri Sembilan until 1904. In 1905 operations were commenced in Pahang, and a chain of major triangulation covering the middle half of the State was carried through to the east coast, and closed on a 25-mile traverse line at the end of 1907.

During the time this work was in progress, revenue or cadastral survey work was actively carried on in the four States. The Perak Revenue Survey Department was formed in 1888; the Selangor Department in 1889, and those of Negri Sembilan and Pahang in 1899. The work of these bodies has been chiefly that of surveying the boundary of alienated lands. Owing to the very rapid mining and agricultural development of the country the

triangulation has hardly kept pace with the cadastral work, which still depends in a large measure on lay traverses connected with the trigonometrical points only at considerable intervals.

The Revenue Survey Departments have also collected a certain amount of topographical information, chiefly in the more settled districts, which have been compiled into maps.

(ii.) Existing State of the Surveys.

The longitude of Penang was determined by the Admiralty Hydrographic Survey in 1893 by telegraphic exchange with Singapore.

The latitude of Taiping has been satisfactorily determined by the Trigonometrical Survey.

The triangulation is now completed over the whole of Perak Selangor and Negri Sembilan, and over the central belt of Pahang. There remains to be done a certain amount of secondary and a considerable amount of tertiary triangulation.

The average triangular error of the principal and secondary work is 3·5 seconds of arc.

No topographical survey has been done.

A large amount of good cadastral work has been done in Perak and Selangor, and a small quantity in Negri Sembilan and Pahang. The work is in the form of traverses along roads and round public or private boundaries, and, in general, the preparation of accurate property plans for attachment to title deeds and for all Land Office purposes. The compilation of general cadastral sheets is carried on *pari passu*.

(iii.) Existing State of the Maps.

These are all compilations based upon the trigonometrical points and the traverses of the Revenue surveys filled in with topographical detail collected by both departments.

The following have been published :—

Perak	4 miles	to	1 inch	... 1891.
Selangor	2 „		1 „	... 1904.
Negri Sembilan	2 „		1 „	... Under publication.

(iv.) Organization.

The surveys are at present organized into five separate departments, a Federal Trigonometrical Survey under a Chief Surveyor responsible to the Resident-General, and four Revenue Survey Departments, one in each of the States—Perak, Selangor, Negri Sembilan and Pahang. The Revenue surveys are under the orders of the respective Residents, but for the purpose of harmonising the work they are all placed under the general

supervision of a Federal officer, the Commissioner of Lands and Surveys. No officers are employed. The lower grades are staffed by Malays.

(v.) Inspection of the Department.

In 1906 very large arrears of Revenue survey work had accumulated while, at the same time, great difficulty was experienced in getting competent men to fill vacancies in the staff. For these and other reasons it was considered desirable that an independent inspection of the department should be made, and the Secretary of State for the Colonies deputed Major E. H. Hills, C.M.G., R.E., to visit the country and report upon the whole question. Major Hills arrived at Penang on 13th June, 1907, and submitted a report dated 16th July, 1907.

In this report it was in the first place strongly urged that the existing arrangement of separate Revenue Survey Departments in each State was highly unsatisfactory, and that the first reform should be to amalgamate these together with the trigonometrical survey into one department under a competent Surveyor-General.

Various recommendations were made as to the pay and status of the survey staff, and as to the recruitment, training and pay of natives employed. Owing to the approaching completion of the principal triangulation, it was pointed out that a convenient opportunity offered for starting a systematic topographical survey, and it was recommended that two selected members of the staff should be sent to India to go through a six months' training in plane table work in a forest country.

Certain alterations of method in the Revenue survey work were suggested, and it was pointed out that the formation of a Federal Survey Department would call for the erection of head-quarter survey offices at Kuala Lumpur.

Major Hills's main recommendation was at once accepted by the Secretary of State for the Colonies, and the new post of Surveyor-General was offered to and accepted by Colonel H. M. Jackson, R.E. It is hoped that he will take up his duties in August, 1908. In the meantime, while the other recommendations in the report are concurred in by the Colonial Survey Committee, it has been thought better to recommend to the Secretary of State that their translation into action should be deferred until the new Surveyor-General shall have had time to make himself acquainted with the conditions, and until the new department shall have been fully constituted.

VI.

GEODESY.

The Geodetic Triangulation of South Africa, which has been entirely paid for by the Colonies concerned and by the British South Africa Company, has reached a stage of practical completion. The geodetic triangulations of the Transvaal, the Orange River Colony, and Basutoland are complete (those of the Cape Colony and Natal were finished as far back as the year 1892), and the arc of the 30° meridian has been measured as far north as a point within 70 miles of Lake Tanganyika. The final volume of results is now in the press. The execution of this great triangulation is chiefly due to Sir David Gill, who initiated the work and has been for 25 years responsible for the general control and supervision of it. The actual carrying out of the work in the field has been throughout in the hands of Colonel Sir William Morris, assisted by a competent staff.

The Arc of the 30° Meridian to the West of Uganda is now being measured. It was pointed out to various Learned Societies that the presence of the Anglo-Congolese Boundary Commission in the region in question afforded a very favourable opportunity for the measurement of 2½ degrees of the arc at comparatively small expense. As a result the Royal Society, the Royal Geographical Society, the Royal Astronomical Society, and the British Association approached the Secretary of State for the Colonies with an offer of a sum of £1,000 towards the expenses of the undertaking. The offer was accepted, and after some correspondence with the Government of the Congo Free State, it was decided to organize a joint measurement of the arc from 1° S. latitude to about 1½° N. latitude. The British Government appointed Mr. G. T. McCaw as observer, and the Congo Government M. Dehalu. The operation is under the general control of the Boundary Commissioners or their representatives, and its success will very largely depend on the weather.

VII.

HYDROGRAPHIC SURVEYS.

LAKE VICTORIA.

Instructions for the survey of the southern portion of Lake Victoria, which lies in German East Africa, were given to Commander Whitehouse, R.N., in April, 1902.

He was assisted by Mr. C. S. Hunter, Civil Engineer, of the Uganda Railway Staff, who remained at work till incapacitated by illness at Nassa (Speke Gulf) in July, 1904.

The field work lasted from 21st August, 1902, to 18th June, 1906, with a recess of five months from April, 1903, and another of three months from April, 1905. These breaks were due in each case to the effect which the work and climate had on Commander Whitehouse's health, making it imperative for him to return for a time to England.

The main survey was on a scale of $\frac{1}{4}$ inch to one geographical mile. Harbours and roadsteads were surveyed on scales up to 12 inches to one mile.

Large additions were made during the work, as opportunity offered, to the survey of the northern portion of the Lake.

The triangulation round the south shores of the Lake was calculated (after the field work was completed), and as the terminal points were also points in the triangulation of the Anglo-German Boundary Commission round the north end of Lake Victoria, a good opportunity of checking the probable accuracy of the survey was afforded.

The difference in position of station Mizinda, calculated by the two series from the same starting station, Mohuru, was only 3·27 seconds in latitude and 0·86 seconds in longitude.

This is a very satisfactory result. The detail of the present chart cannot be considered exhaustive, but it will probably be some time before the traffic on the lake has so increased as to make more detailed surveying necessary.

VI.

CLASSIFIED LISTS OF THE STAFFS OF THE SURVEY DEPARTMENTS.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	NYASALAND.				
Director of Public Works and Survey.	T. J. Binnie	450–600, by £25.	£100 personal ...	Permanent ...	1st Dec., 1900.
Assistant Surveyor	T. J. Firr	325–425, by £20.	£12 10*s.* electric light.	„ ...	25th May, 1902.
„ „	J. Bannerman	250–325, by £15.	„ „ „	„ ...	1st June, 1901.
„ „	G. N. Beaumont	200–300, by £10.	„ „ „	3 years' agreement	5th Dec., 1905.
Clerk	E. Taylor	200–300, by £10.	£20 subsistence ...	... ...	6th July, 1906.
„	H. R. Cruise	„	„ „ ...	... ...	25th Oct., 1906.
	EAST AFRICA.				
	Superintending Staff.				
Director of Surveys	Major G. E. Smith, R.E. ...	800	... ...	3 years	—
Clerk and Storekeeper ...	Mr. A. Rehm	250	... ...	... ...	4th Jan., 1906.
	Trigonometrical Branch.				
Deputy Director of Surveys ...	Capt. G. S. Knox, R.E. ...	667	... ...	3 years	16th March, 1906.
Assistant „ Survey „ ...	Lieut. E. W. Cox, R.E. ...	525	... ...	„	16th March, 1906.

Surveyor	Coy. Sgt.-Major H. Cox, R.E.	285	... ...	,, ...	16th March, 1906.
,, ...	Corpl. W. Macdonald, R.E. ...	215	... ...	,, ...	28th April, 1906.
	Cadastral Branch.				
Deputy Director of Surveys ...	Mr. E. L. Waring	500	... ...	... ...	1st April, 1906.
Assistant ,, ,, ...	Mr. A. E. Townsend	400	... ...	... ...	August, 1906.
District Surveyor	Mr. T. H. Galbraith	360	... ...	3 years	—
,, ,, ...	Mr. J. P. Clark	360	... ...	... ...	14th July, 1904.
Senior Staff Surveyor ...	Mr. F. M. Lamb	300	... ...	3 years	—
,, ,, ,, ...	Mr. L. H. Lloyd	300	... ...	3 years	15th July, 1904.
,, ,, ,, ...	Mr. G. Woodruff	300	... ...	... ...	—
,, ,, ,, ...	Mr. W. Nightingale	300	... ...	... ...	—
,, ,, ,, ...	Mr. J. T. Stiles...	300	... ...	... ...	1st April, 1908.
Junior Staff Surveyor ...	Mr. F. Lind	250	... ...	... ...	—
,, ,, ,, ...	Mr. F. Smythe	250	... ...	... ...	—
,, ,, ,, ...	Mr. J. Marsengo	250	... ...	... ...	—
,, ,, ,, ...	Mr. J. Spalding...	250	... ...	3 years	—
,, ,, ,, ...	Mr. D. G. Crofts	250	... ...	... ...	27th Sept., 1907.
Chief Computer and Examiner	Mr. Panting	200	£40 house allowance	... ...	—
Clerk and Accountant ...	Mr. G. Bunting...	175	,, ,, ,,	... ...	—
Assistant Clerk and Accountant.	Mr. W. T. West	140	,, ,, ,,	... ...	4th July, 1908.
	GOLD COAST.				
Director of Surveys	Capt. E. F. W. Lees	700	£140 duty allowance, £36 horse allowance.	Pensionable. 3 years on probation.	4th Jan., 1908.
Chief Surveyor	L.-Corpl. G. V. Mathieson, R.E.	400	£80 duty allowance, £36 horse allowance.	,, ,, ,,	,, ,,
Surveyor	2nd Corpl. R. N. Kilby, R.E....	250–10–300	Horse allowance £36	,, ,, ,,	,, ,,

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	GOLD COAST—*continued.*				
1 Native Surveyor	J. B. Esuwan-Gwira	200–10–250	£9 bicycle allowance	3 years on probation. Pensionable.	1 Jan., 1908.
2 Native Assistant Surveyors (2nd Class)	E. J. Smith	120–5–150	" " "		
	T. H. Vaughan				
1 Native Draughtsman ...	R. Josiah	120–5–150	" " "		
1 4th Grade Clerk	... ...	60–5–80	... ...		
	SOUTHERN NIGERIA.				
Director of Surveys	Mr. E. P. Cotton	700	£100 duty allowance	Pensionable ...	29th Oct., 1906.
Deputy Director of Surveys...	Mr. A. Cleminson	400–500, by £20.	£80 duty allowance	" ...	1st Jan., 1907.
Senior Surveyor	Vacant	... ...	... ...	" ...	—
2 Surveyors	Mr. F. W. H. Black ...	300–400, by £20.	... ...	" ...	1st Jan., 1908.
	Mr. R. A. Webb ...				
3 Temporary Surveyors	Mr. R. L. Drouyn ...	350	... ...	Non-pensionable, by agreement.	17th Oct., 1905.
	Mr. E. N. Thomas ...		... ...	" " "	16th May, 1908.
	Mr. J. Scott		... ...	" " "	6th June, 1908.
Draughtsman	Mr. W. J. F. Lomax	350	... ...	" " "	13th Oct., 1906.
	UGANDA.				
Director of Surveys	Mr. R. C. Allen...	500–700, by £25.	... ...	... ...	30th Nov., 1900.
Deputy Director of Surveys...	Mr. W. V. Morris	325–425, by £20.	... ...	... ...	27th July, 1902.

Senior Surveyor	Mr. E. Richardson	360–20–400	... ...	3 years' agreement (Re-engaged for 3 years).	8th April, 1904.
,, ,, ...	Mr. E. G. Fenning	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
,, ,, ...	Mr. L. R. Fraser	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
Junior Surveyor	Mr. L. M. Seth-Smith	300	... ...	3 years' agreement (Re-engaged).	3rd June, 1904.
,, ,, ...	Mr. A. Richardson	300	... ...	3 years' agreement (Re-engaged for 30 months).	1st June, 1903.
,, ,, ...	Mr. J. T. W. S. McGregor ...	300	... ...	3 years' agreement (Re-engaged for 3 years).	17th July, 1903.
,, ,, ...	Mr. H. Boazman	350	... ...	3 years' agreement (Re-engaged for 30 months, 12/2/07).	17th July, 1903.
,, ,, ...	Mr. J. P. Tolland	300	... ...	3 years' agreement from date of arrival in Africa (not reported).	—
,, ,, ...	Mr. A. H. Gee	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. R. J. Goulston	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. V. F. Mayne	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. A. C. Willmott	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. H. J. Woram	285	... ...	,, ,, ,,	—
,, ,, ...	Mr. A. J. Jones	215	... ...	,, ,, ,,	—
,, ,, ...	Mr. W. Richardson	215	... ...	,, ,, ,,	—
,, ,, ...	Mr. J. Rimmer	215	... ...	,, ,, ,,	—

Name.	Appointment.	Salary. £	Date of Appointment.
	CEYLON.		
P. D. Warren	Surveyor-General	Rs. 13,812	23rd June, 1904.
R. S. Templeton	Assistant Surveyor-General	Rs. 9,900	23rd June, 1904.
L. Shipton	Superintendents of Surveys	400–25–450	4th May, 1907.
C. B. P. Meadon	Superintendents of Surveys	400–25–450	1st Oct. 1907.
G. R. Thornhill	Superintendents of Surveys	400–25–450	?
A. H. G. Dawson	Superintendents of Surveys	400–25–450	1st Jan., 1908.
D. Bloxham	Assistant Superintendents of Surveys	300–25–550	5th Oct., 1907.
C. H. Vince	Assistant Superintendents of Surveys	300–25–550	? 12th June, 1908.
H. M. C. Ledger	Assistant Superintendents of Surveys	300–25–550	? 12th June, 1908.
E. B. Manson	Assistant Superintendents of Surveys	300–25–550	? 12th June, 1908.
F. J. Salmon	Assistant Superintendents of Surveys	300–25–550	? 12th June, 1908.
J. A. Loram	Assistant Superintendents of Surveys	300–25–550	? July, 1908.
H. W. Johnson	Assistant Superintendents of Surveys	250–10–300	22nd May, 1908.
E. E. O'Leary	Assistant Superintendents of Surveys	250–10–300	22nd May, 1908.
P. B. Lynch	Assistant Superintendents of Surveys	250–10–300	22nd May, 1908.
J. Reid	Assistant Superintendents of Surveys	250–10–300	5th June, 1908.
F. E. Dainty	Assistant Superintendents of Surveys	250–10–300	5th June, 1908.
G. A. Robertson	Assistant Superintendents of Surveys	250–10–300	5th June, 1908.
	FEDERATED MALAY STATES.		
E. C. P. Clare (promotion)	District Surveyor, Negri Sembilan	420	? 20th Nov., 1907.
Bt. Col. H. M. Jackson	Surveyor-General	1,200	Aug., 1908.

M. Olphert	1st Grade Revenue Surveyors	420	30th Nov., 1907.
R. V. Morris			22nd Feb., 1908.
H. E. Winckler			29th Feb., 1908.
W. A. Gummer, O. Krook, A. Cochrane, A. Schreiber, — Clarke, — Tofft (From New South Wales)			? Feb., 1908.
J. Griffiths			11th April, 1908.
W. S. Sloan			25th April, 1908.
T. Y. Bremner	... ...	330-360 This salary, which is lower than that of a 1st Grade Revenue Surveyor, has been given as Mr. Bremner is not fully qualified.	? Jan., 1908.

COLONIAL REPORTS.

The following recent reports relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

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534	Gold Coast	"
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536	Gambia	1906
537	British Central Africa Protectorate	1906–1907
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540	Straits Settlements	1906
541	Turks and Caicos Islands	"
542	Somaliland Protectorate	1906–1907
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52	South Africa	Native Education.

COLONIAL REPORTS—ANNUAL.

No. 608.

THE SURVEYS

OF

BRITISH AFRICA, CEYLON, THE FEDERATED MALAY STATES, JAMAICA, TRINIDAD, BRITISH HONDURAS, FIJI.

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

FOURTH YEAR.

To 31st March, 1909.

(For Report for 1907–8, *see* No. 565.)

Presented to both Houses of Parliament by Command of His Majesty.
August, 1909.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY DARLING & SON, LTD., 34-40, BACON STREET, E.

And to be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LTD., FETTER LANE, E.C., and
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1909.

[Cd. 4448-17.] *Price* 1s. 7d.

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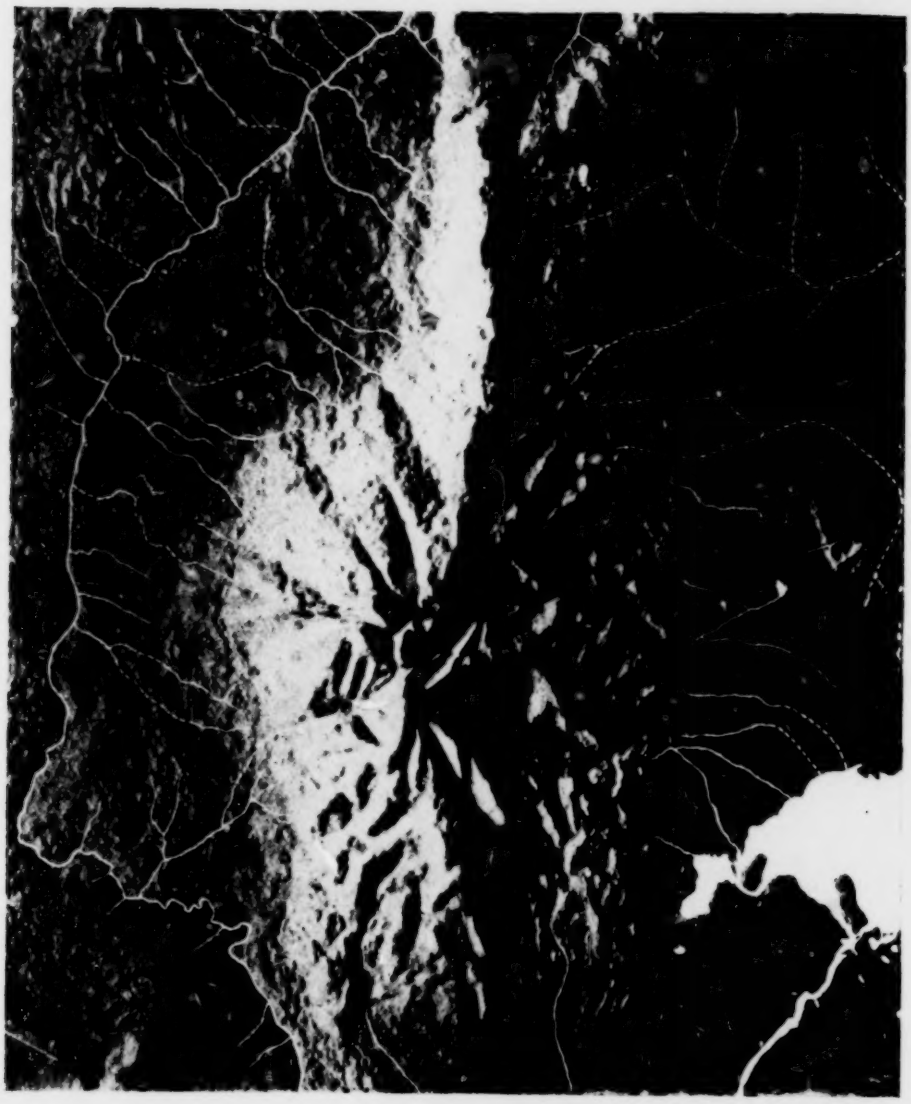
Ruwenzori,
The Semliki River, and Lake George.

Scale $\frac{1}{1{,}000{,}000}$ (about 16 miles to 1 inch).



Photograph of a model constructed from the maps of the Anglo-Congolese Boundary Commission of 1907–08.

No 608.

COLONIAL SURVEY COMMITTEE REPORT.

FOR THE YEAR ENDING 31ST MARCH, 1909.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

This report differs from that of last year, which dealt with the surveys of British Africa, Ceylon, and the Federated Malay States, in that brief accounts of the surveys of Jamaica, Trinidad, British Honduras, and Fiji, are also included.

S. C. N. GRANT, *Colonel, D.G., O.S.*
H. J. READ.
C. F. CLOSE, *Lt.-Col., Gen. Staff.*

W. C. BOTTOMLEY,
Secretary.

3rd August, 1909.

(13739—2.) Wt. 26122—322. 1125. 8/09. D & S.

I.

REVIEW OF WORK IN AFRICA DURING THE PAST YEAR.

Topographical Surveys.—During the past year a total of about 28,000 square miles has been topographically surveyed in British Africa, exclusive of boundary commission surveys.

Gold Coast	150	sq. miles.
South Africa—		
Basutoland	2,500	„ „
Cape Colony	14,500	„ „
Orange River Colony	7,100	„ „
East Africa	630	„ „
Uganda	3,200	„ „

NOTE.—An area amounting to about 13,000 square miles has also been surveyed in Southern Nigeria, but portions of this work will require revision.

Rough Surveys and Explorations have been carried out in the Anglo-Egyptian Sudan, Nyasaland, and Sierra Leone.

Geodesy.—The work of measuring an arc of meridian in Uganda was completed by the joint Anglo-Congolese party in February, 1909. This arc is about 165 miles long and extends from 1° 10′ N. to 1° 10′ S.

The following societies contributed towards the cost of the measurement:—The Royal Society, the Royal Geographical Society, the Royal Astronomical Society and the British Association for the Advancement of Science.

Cadastral Surveys have been in progress in the Anglo-Egyptian Sudan, East Africa, the Gold Coast, Nyasaland, Southern Nigeria and Uganda.

Boundary Commissions.—The following commissions completed their work during the past year:—

(i.) The Anglo-German, Yola-Cross River Commission (British Commissioner Lieut.-Col. G. F. Whitlock, R.E.), has completed the survey of 320 linear miles of frontier between Yola and the rapids of the Cross River.

(ii.) The East Africa-Sudan-Abyssinia Commission (British Commissioner Major C. W. Gwynn, C.M.G., D.S.O., R.E.), has completed the survey of about 600 linear miles of frontier to the north of the East Africa Protectorate.

The total area surveyed and explored by the above boundary commissions amounts to 34,000 square miles.

Railway Surveys.—A party under the command of Captain A. G. Stevenson, D.S.O., R.E., has been investigating and surveying possible railway routes from Lake Victoria to Lake Albert.

A section of this party under Lieut. C. E. Fishbourne, R.E., was employed on the exploration of the Lake Kioga region.

Inspection.—Major E. H. Hills, C.M.G., was deputed to inspect and report upon the survey department of Southern Nigeria.

General remark on the systematic exploration and survey of British Tropical Africa.

During the past year a regular topographical branch of the Survey Department of East Africa has been established; steps have been taken to expedite the topographical survey of Uganda; the state of the survey of Southern Nigeria has been investigated and reported upon; these and various other measures directed towards the prosecution of the systematic survey of British Tropical Africa will not produce any marked effect in the returns of areas completed until the year 1910.

II.

REGULATIONS AFFECTING SURVEY DEPARTMENTS.

(i.) The Spelling of African Place Names.

The Secretary of State has approved of the following rules for the spelling of place names in British Tropical Africa:—

(*a*) Established forms of spelling of well known places are to be retained, *e.g.*, Coomassie, Accra.

(*b*) The spelling of other place names is to be in accordance with the rules of the Royal Geographical Society. (Briefly, in this system, the consonants are as in English and the vowels as in Italian.)

(*c*) The Director of Surveys in each Colony or Protectorate (or where there is no Director of Surveys, the Intelligence Officer), is responsible for the correctness of the spelling of the place names on field sheets sent home for reproduction. He will ascertain the true pronunciation from Commissioners and Residents.

In any case in which it is doubtful whether a name should be dealt with under (*a*) or (*b*) he will refer the question to the Governor for decision.

(ii.) Appointments to Survey Departments.

Candidates for junior appointments in the Survey Departments dealt with in this report, will, if provisionally selected, be sent to the Ordnance Survey, Southampton, for a month's course of instruction in surveying. If during this course the Director General of the Ordnance Survey reports that the candidate is unfitted for the post to which he has been provisionally appointed, the candidate will be withdrawn from the course, and will not receive the appointment.

III.

TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners	Dates of				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed	Finally approved.	
1	Gambia (Anglo-French)	425	Aug. 10th, 1889	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Lecomte, Civil Administrator.	Nov., 1890, to May, 1891	May, 1891	June 9th, 1891.	—	—
1	" "	—	" "	British :— Mr. Reeve. Mr. Ozanne. French :— M. Fargue. Lieut. de Jussien. M. Robert (Interpreter).	1895-6.	—	—	—	—
1	" "	—	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898-9.	—	—	—	—
1	" "	—	April 8th, 1904	British :— Major Cowie, W.I.R. Mr. B. B. de Tscharner.	1905-6.	—	—	—	—
2	Sierra Leone—French Guinea.	260	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Capt. A. H. Kenney, R.E. French :— M. Lamadon, Governor of the French Colony of Les Rivières-du-Sud.	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembi-Kunda.
2	" "	—	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Miliot.	Dec., 1895, to May, 1896.	1895, 1896	April 9th and 30th, 1896.	June 14th and 16th, 1898.	From the Coast to Tembi-Kunda.

2	Sierra Leone—French Guinea.	8	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Mr. Birch. French :— M. Lescure.	1900 and Jan. 15th, 1903.	1903.	Mar. 12th, 1903.	Exchange of notes, Mar. 22nd and April 5th, 1904.	Tembi - Kunda Eastwards.
3	Sierra Leone—Liberia ..	193	Nov. 11th, 1885	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E. Liberian :— Mr J. McCarthy.	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	—	—
4	Gold Coast—Ivory Coast (Anglo-French).	450	July 12th, 1893	British :— Major A. E. G. Watherston, R.E. Capt. Soden, R. Fus. Capt. H. B. Des Voeux, R.E. French — M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903.	Feb. 1st, 1903.	May 11th and 15th, 1905.	—
5	Gold Coast, Northern Territories — French Sudan, Senegambia-Niger (Anglo-French Boundary North of Gold Coast).	195	Convention, June 14th 1898.	British :— Major A. E. G. Watherston, R.E. Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	—	Aug. 16th, 1901.	—	—
5	" "	"	Agreement, Mar. 18th/ April 25th, 1904.	British :— Capt. J. O'Kinealy. French :— Lieut. F. Verlaque.	—	1904.	Oct. 19th, 1904.	May 24th/ July 19th, 1906.	—
6	Gold Coast, Northern Territories — Togo (Anglo-German).	165	Convention, Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E. Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried.	Dec., 1901, to Sept., 1902.	—	July 21st, 1902.	—	—
6	" "	"	" "	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.	—	Sept., 1904, to Dec. 15th, 1905.	—	June 25th, 1904.	North of 9th parallel only.
7	Gold Coast — Togoland (Anglo-German)	125	Convention, July 1st, 1890.	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	1904.	Oct. 11th, 1904.	—	—

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	REMARKS.
8	Lagos—Dahomey (Anglo-French).	235	June 14th, 1898	British :— Major J. I. Lang, C.M.G., R.E French :— Commdt. Touteé.	1900.	—	Dec. 22nd, 1900, and Jan., 1905.	Oct. 19th, 1906.	From 9° N. Lat. to Niger. In one exchange of notes.
9	" " ..	200	August 10th, 1889, July 12th, 1893.	British :— Mr. F. C. Fuller. Mr. A. G. Fowler. Dr. Hay. French :— Capt. J. Plé. Lieut. Brisson	1895-6.	—	Oct 12th, 1893. Art. II. June 14th, 1898.	Oct. 19th, 1906.	From the Coast to 9° N.Lat. Treaty Series No. 15, 1899.
9	" " ..			British :— Capt. Anderson. French :— M. Perreur.	1900.	—	—	—	—
10	Niger—Chad (Anglo-French).	860	June 14th, 1898, April 8th, 1904.	British :— Lieut.-Col. G. S. McD. Elliott, R E. Capt. C. H. Foulkes, R.E. Capt. G. R. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty. Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906, May 29th, 1906.	—	—
10	" " "	"	May 29th, 1906	British :— Major R. P. O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Andoin. Lieut. Vignon.	1906, 1907.	1907, 1908	Feb. 25th, 1908.	—	—

11	Yola—Chad (Anglo-German).	350	Convention, Nov. 15th, 1893 Preliminary Agreement, Dec. 2nd, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E. Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B. Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Aug. 10th, 1905, Feb., 1903, to Feb., 1904 and 1905.	—	Feb. 24th, 1904, and Mar. 19th, 1906.	July 16th, 1906.	(Treaty Serie No. 17, 1906).
11	" "	40	" "	Local Commission to mark Boundary :— British :— Mr. Hans Fischer. German :— Leut. von Stephani.	—	1906 to 1907.	Feb. 12th, 1907.	Mar. 5th, 1909.	From Gorege to Lake Chad. (Treaty Series, No. 17, 1909).
11	" "	81	" "	British :— Capt. Vicars Boyle. German :— Capt. von Stephani.	—	1907.	Mar. 11th, 1907.	Mar. 5th, 1909.	From Uba, on Yedseram River, to River Benue.
12	Cross River (Southern Nigeria—Kameruns).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug. 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1895.	—	—	—	Cross River to the Sea.
12	" "	"	" "	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	
13	Cross River Rapids—Yola Arc.	285	Nov. 15th, 1893	British :— Lieut-Col. G. F. A. Whitlock, R.E. Capt. H. T. G. Moore, R.E. Lieut. W. V. Nugent, R.A. 2nd Lieut. W. D. Downes, Royal Sussex Regiment. German :— Major Haering. Oblt. von Stephani. Oblt. Cuno. Oblt. Rothe.	Aug., 1907, to May, 1909.	1907 to 1909.	-	-	-

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	Remarks.
14	Barotseland—Angola ..	710	Convention, July 11th, 1891, and Arbitration award, May 30th, 1905.	—	—	—	—	—	Not yet delimited.
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	—	—	—	—	—	Not yet delimited.
16	Bechuanaland—German South-West Africa.	1113	July 1st, 1890, Art. III. (A.G.); Dec 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British :— Major H D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1896 to 1903.	—	—	Part only of boundary delimited.
16	Cape Colony—German South - West Africa (Orange River).		July 1st 1890, Art. III.	—	—	—	—	—	Not yet delimited.
17	Amatongaland — Portuguese East Africa.	80	June 11th, 1891, Art. III	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	Aug., 1896, to Dec., 1896	—	—	—	—
17	" "	"	" "	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	—	Aug. and Oct., 1897.	Oct. 2nd, 1897.	Dec. 29th, 1898/Jan. 25th, 1899.	—
18	Swaziland — Portuguese East Africa.	65	Conference, April to June, 1907.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1888, 1894, and 1897.	April, 1907	—	—	Portuguese and Boer Commission.

19	Transvaal — Portuguese East Africa.	253	July 29th, 1869. Convention of London, Feb. 27th, 1884.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1887, 1890, and 1894.	1887, 1890, 1894.	—	—	Portuguese and Boer Commission.
20	Limpopo River to Sabi River (Anglo - Portuguese).	115	June 11th, 1891	British :— Mr. W. J. Atherstone. Portuguese :— José A. Serrano.	Dec. 1902, to July, 1903.	—	Dec. 21st, 1903/July 19th, 1904.	June 3rd, 1907.	In one exchange of notes.
21	Mazoe or Manica Boundary (Anglo - Portuguese 18° 30′ S. to Sabi River).	235	June 11th, 1891, and Arbitral award, Jan. 30th, 1897.	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	June 3rd, 1907.	In one exchange of notes.
21	" "	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. Freire D'Andrade.	—	1898, 1899.	June 5th and 28th, 1898, and Dec. 14th and 15th, 1898.	—	-
22	Barue Boundary (Anglo-Portuguese, River Mazoe, and 18° 30′ South).	145	June 11th, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E.	1898.	1905 to	Dec. 28th, 1898.	Mar. and April, 1902, Jan. and April, 1904.	Exchange of notes.
23	Anglo-Portuguese Boundary South of River Zambesi.	215	" "	British :— Mr. Sawerthal. Portuguese :— Lieut. Durao.	1903-4.	—	—	—	Provisional survey.
23	" "	215	" "	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. S. Gugo Coutinho.	April 1905, to Oct., 1905.	1905.	Oct. 4th, 1905.	—	—

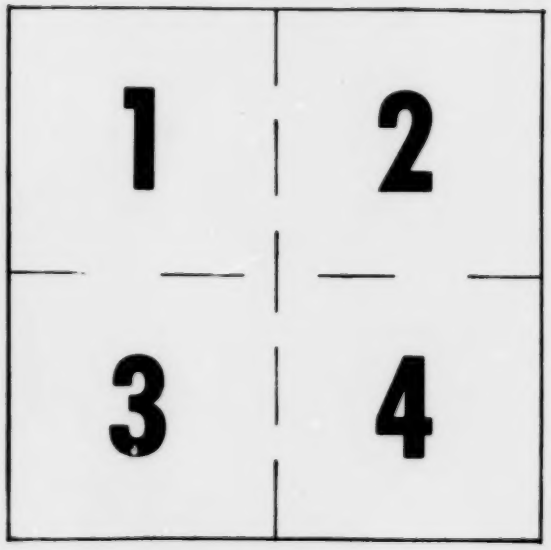
Red Nos. on Map.	Name of Boundary.	Length, Miles	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved	REMARKS.
24	Anglo-Portuguese Boundary North of Zambesi.	260	June 11th, 1891	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. S. Gugo Coutinho.	June, 1904, to Nov., 1904.	1904.	Nov. 21st, 1904.	—	—
25(*a*)	Nyasaland Protectorate—Portuguese East Africa (Anglo-Portuguese)	660	„ „	British :— Mr. J. F. Cunningham. Mr. T. I. Binnie, Surveyor. Portuguese :— Capt. Ferraz. Conde. Du Pont. Capt. Branco.	July to Nov., 1899. Oct. to Dec., 1900.	1899-1900.	Dec. 8th, 1900.	*Sept. 15th, 1906.	Section from River Ruo to Lake Chiuta } Provisional Boundary Commission.
25(*b*)	„ „			British :— Mr. A. James Swann. Mr. Thomas I. Binnie, Surveyor.					
25(*c*)	„ „	91	„ „	Local Commission :— British :— Mr. A. J. Swann. Mr. T. F. Firr, Surveyor. Portuguese :— 2nd Lieut. Antonio de Brito.	—	1907.	—	—	To make some alterations to previous line. Beaconed from B.P. 38 to Mt. Kapirinta.
25(*d*)	„ „	—	June 11th, 1891	Local Commission :— British :— Mr. T. I. Binnie. Portuguese :— Ernesto Tavares D'Almeido Carvalho.	April-May, 1908.	—	May 22nd, 1908.	—	Ruo and Shire Rivers.
26	Nyasa-Tanganyika (Anglo-German).	225	July 1st, 1890	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Boileau, R.E. Capt. Chichester. Lieut. Scratchley. German :— Hptmann Herrmann. Lieut. Glauning. Dr. Kohlschütter.	1898.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—
27	Congo Free State—North-West Rhodesia.	1,200	May 12th, 1894	—	—	—	—	—	Not yet delimited.

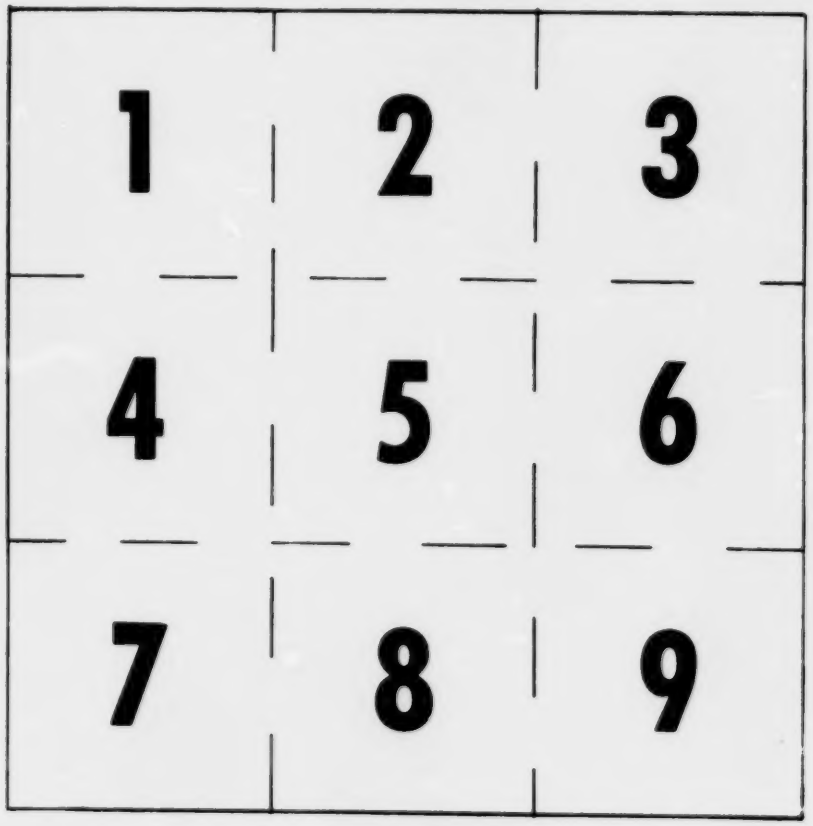
28	Congo Free State—Uganda and Sudan.	800	May 12th, 1894, and May 9th, 1906.	British :— Lieut.-Col. R. G. T. Bright, C.M.G., Rifle Brigade. Capt. E. M. Jack, R.E. Lieut. Hon. F. R. D. Prittie, Rifle Brigade. Congolese :— Commandant E. Mercier, 2nd Regiment des Guides. Commandant J. Bastien, 2nd Regiment des Grenadiers. Commandant Stockhausen. Lieut. Weber. Lieut. Mauray.	Jan., 1907 to April, 1908.	—	—	—	—
29	British — German East Africa (Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith, R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 25th, 1893.	—	—
29	" " "	"	July 25th, 1893	British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897.	1900.	Jan. 23th, Feb. 14th, and April 25th, 1900.	—	Not beaconed throughout its entire length.
30	British — German East Africa (South end of Jipe to Lake Victoria).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright, Rifle Bde. Lieut. T. T Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	—
30	German East Africa—Uganda.	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	July, 1902, to Apr. 1904.	1904.	July 18th, 1906.	—	—
31	Italian Somaliland — British East Africa.	375	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
31(a)	British Somaliland — Abyssinia.		May 14th, 1897, June 4th, 1897.	—	—	—	—	—	Not yet delimited.

* Provisional confirmation of recommendations of Boundary Commissioners, 1899 and 1900 (Procès Verbal, December 8th, 1900).

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS.
32	British Somaliland — Italian Somaliland.	710	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
33	British Somaliland — French Somali Coast.	50	February 2nd, 1888 ..	—	—	—	—	—	Not yet delimited.
34	Uganda and East Africa —Abyssinia Boundary.	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900-01.	—	—	—	—
34	" " "	"	—	Capt. P. Maud, R.E. Mr. J. Baird.	Oct. 1902, to July, 1903.	—	—	—	—
34	" " ..	"	December 6th, 1907 ..	Major C. W. Gwynn, C.M.G., D.S.O., R.E. Capt. R. L. Waller, R.E.	1908. 1909.	1908. 1909.	—	—	—
35	Sudan—Abyssinia ..	760	Treaty, May 15th, 1902	Major H. H. Austin, R.E. Lieut. C. W. Gwynn, R.E.	—	—	—	—	—
35	" " ..	"	" " "	Brev.-Major C. W. Gwynn, R.E., D.S.O.	1903.	1903.	—	—	—
36	Sudan—Eritrea	330	December 7th, 1898, June 1st, 1899, April 16th, 1901, November 22nd, 1901, May 15th, 1902.	British :— Col. the Hon. M. G. Talbot, R.E. Italian :— Major Martinelli. Tenente. A. Pollera. Capt. Tornare.	1903.	—	—	—	R. Setit to Abu Gamal.
36	" " ..	"	" " "	Brev.-Major W. J. Walter, Lancs. Fus.	1899, 1901.	—	—	—	From Sabderat North - Eastwards.
37	Anglo - French — From Congo-Nile Watershed to Tripoli.	1,950	March 21st, 1899 .. Treaty, Series 15, 1899.	—	—	—	—	—	Not yet delimited.
38	Egypt—Tripoli	1,000	—	—	—	—	—	—	Not yet delimited.
39	Egypt—Turkish, Sinai Peninsula.	140	Firman, 1841	British :— Capt. R. C. Owen. Mr. Wade. Mr. Keeling. Turkish :— Mazzaffer Bey. Fehim Bey.	1906.	1906.	—	Oct. 1st, 1906.	—

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





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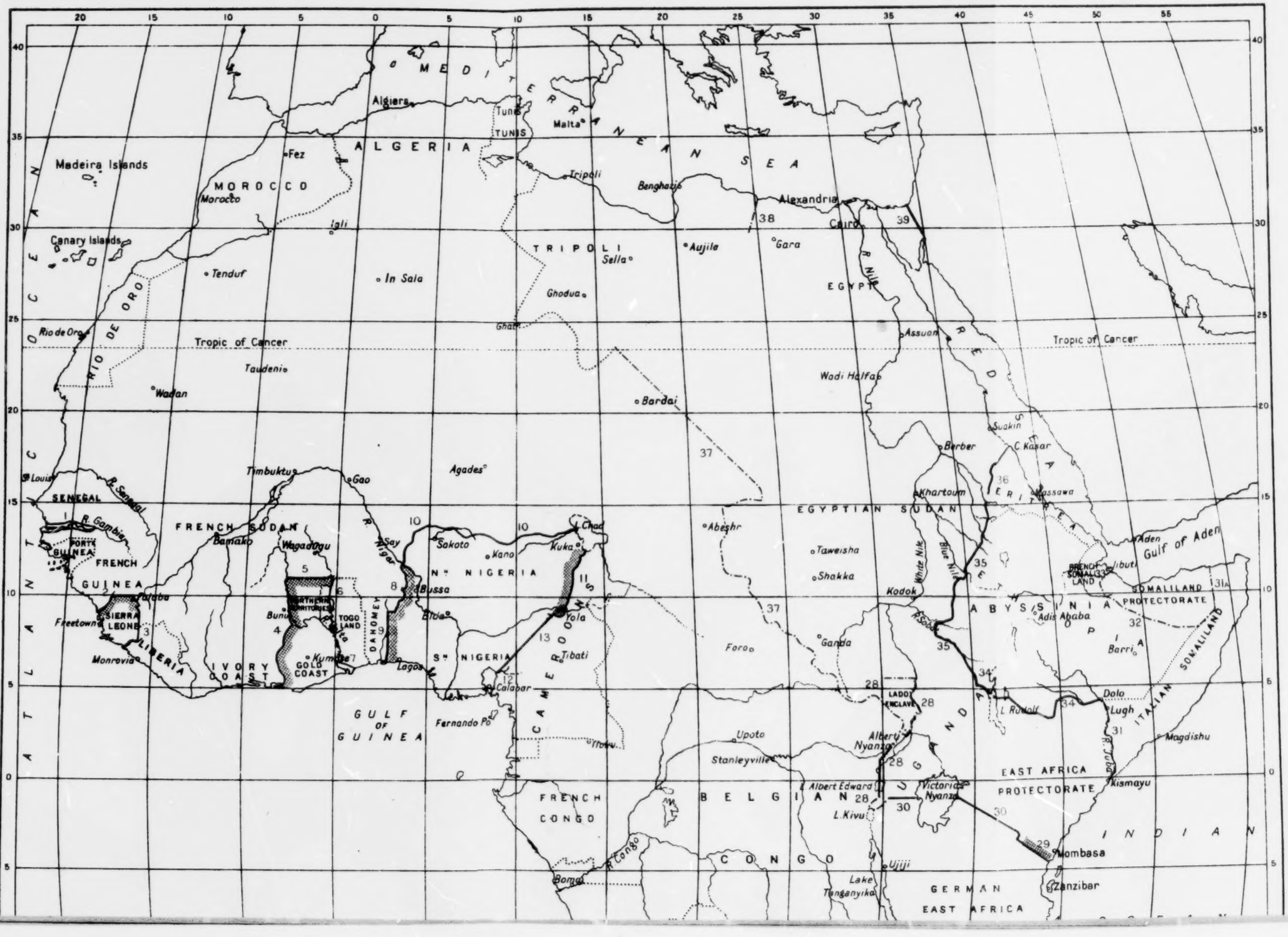

DIAGRAM TO ILLUSTRATE THE PROGRESS OF THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA

Scale of the Diagram
26,312,000 or 1 inch to 450 Miles
Miles 100 0 100 300 500 700 900 Miles

British Boundaries marked & ratified
Do Do surveyed
Do Do not yet surveyed

ATLANTIC OCEAN
GUINEA
Labbe
SIERRA LEONE
Freetown
LIBERIA
Monrovia
IVORY COAST
GOLD COAST
Kumasi
Bunduku
TOGO LAND
DAHOMEY
Bussa
Ilorin
Lagos
NIGERIA
Yola
Tibati
CAMEROONS
Calabar
GULF OF GUINEA
Fernando Po
Yaoundé
FRENCH CONGO
Upoto
Stanleyville
Albert Edward L.
L. Kivu
BELGIAN CONGO
R. Congo
Bonga
S. Paul de Loanda
ANGOLA
Benguela
Foroo
Ganda
Kodok
ABYSSINIA
Adis Ababa
SOMALILAND PROTECTORATE
Barrio
ITALIAN SOMALILAND
LADO ENCLAVE
UGANDA
L. Rudolf
Dolo
Lugh
Albert Nyanza
Victoria Nyanza
EAST AFRICA PROTECTORATE
Kismayu
Magdishu
R. Juba
Mombasa
Ujiji
Lake Tanganyika
GERMAN EAST AFRICA
Zanzibar
INDIAN OCEAN
Kazembe
Lake Bangwaolo
R. Rovuma
Lindi
NYASSALAND PROTECTORATE
Lake Nyassa
Sitanda
Lialui
R. Zambezi
Mozambique
PORTUGUESE EAST AFRICA
Kilimane
Victoria Falls
Salisbury
Nyanso
Buluwayo
Sofala
MADAGASCAR
Moremi
GERMAN SOUTH WEST AFRICA
Walfish Bay
Tropic of Capricorn
Inhambane
TRANSVAAL
Pretoria
Lorenco Marques
Bethany
Kuruman
Port Nolloth
ORANGE RIVER COLONY
Bloemfontein
NATAL
Durban
CAPE COLONY
Cape Town
Port Elizabeth

G.S.G.S. Nº 2226 (a)

War Office August 1906.
Revised June, 1909

IV.

REPORTS ON THE SURVEYS OF BRITISH AFRICA.

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THE ANGLO-EGYPTIAN SUDAN.

Sirdar	Major-General Sir F. R. WINGATE, K.C.B., K.C.M.G., D.S.O.
Director of Surveys ...	Captain H. D. PEARSON, R.E.
Assistant - Director of Surveys	Lieutenant A. E. CONINGHAM, R.E.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but it has been thought desirable to include an account of these surveys in order to make the review of the mapping of British Africa more complete.

The following report has been kindly furnished by the Director of Surveys.

Geographical Surveys.

In October, 1908, Captain Coningham joined the expedition about to start for the Southern Kordofan Jebels, and continuing his survey from the trigonometrical stations fixed during the previous year he mapped the country comprising the theatre of operations.

Rigid theodolite triangulation was not possible during the advance, and a combination of plane-table work and compass sketching was resorted to.

On the termination of hostilities, Captain Coningham proceeded to J. Talodi, a station to which the telegraph line had now reached, and signals were exchanged with Khartoum. In the previous year he had marched from Bir Natron, in the desert west of Dongola, to El Obeid using a perambulator and compass, and observing latitudes and chronometric longitudes. The sketches by Captain Lloyd, lately Governor of the Province, of Mr. Macmichael, and other inspectors, have been fitted on the positions so fixed, and maps, probably of fair accuracy, of the whole of Kordofan are now issued.

From J. Talodi, Captain Coningham found his way via L. Abiad and Sultan Rob's to Meshra el Rek and thence to Wan. From Wan he proceeded to Hofra el Nehas, carrying the longitude instrument invented by Mr. Wade, intending to take lunar observations at two or three stations in the Western Bahr el Ghazal.

Mr. Wade's instrument had not previously been used in the field and Captain Coningham was not very hopeful of good results, but chronometers and a perambulator were also carried. He has not yet returned, but, in any case, his long march should enable the maps of this part of the Sudan to be drawn with more confidence than has hitherto been the case.

During 1908 eight telegraphic fixings had been made on the Bahr el Jebel and Bahr el Zaraf. The compass sketches made by the Irrigation Department in the course of their levelling operations have now been adjusted to these positions, and work by Captain Dove and other inspectors in the Upper Nile has been added.

The sheets are now very fairly reliable and information is steadily being collected and inserted.

Up to the present year the course of the river Atbara had only been approximately surveyed ; cadastral survey is now in hand in the lower reaches, and the opportunity has been taken to map the river accurately as far as Goz Regeb. At the same time Mr. Carson has collected much information in the country north of the Khartoum-Kassala Road and between the Atbara and the Nile, and the sheets about to be issued will be more complete and reliable than the previous provisional editions.

The $\frac{1}{250000}$ *Series.*—Before Colonel Talbot left the Sudan, he had prepared some 60 sheets of the $\frac{1}{250000}$ series. Since his departure much new information has come to hand, such as the surveys of the Red Sea and Kassala Railway lines, and an effort has been made to have the whole brought up-to-date. New editions of upwards of 30 sheets have been brought out during the year. During the last four years also 60 new sheets, practically completing the $\frac{1}{250000}$ series, have been produced. Captain Coningham alone has been continuously available for topographical work. Every month, however, some half dozen " time and compass " sketches are received in Khartoum from the inspectors travelling in the provinces. To

reproduce the information collected in the most useful form, it was thought better to hurry out sheets of the whole of the Sudan, however inaccurate, rather than delay the issue till each could be finally dealt with.

It is not pretended, therefore, that these new sheets are of the same degree of accuracy as the former maps, and up to date the majority are merely in the form of sun-prints. A hand printing press has, however, been put up during the year and the more reliable of these latter maps are being transferred to zinc for reproduction.

The $\frac{1}{1000000}$ *Series.*—A complete map on the million scale, has also been compiled for administrative purposes. From the nature of the survey great difficulty is experienced, with this as with the $\frac{1}{250000}$ series, in keeping the maps up-to-date. The number of fixed positions is, however, increasing every year and the cases in which, on revision, complete re-drawing is found to be necessary will gradually disappear.

The longitudes of the following places have now been determined telegraphically :—

Abu Hamed.
Awoi.
Berber.
Bor.
Debba.
Deim Zubeir.
El Dueim.
El Obeid.
Gedaref.
Goz Abu Guma.
J. Barkal.
Jebelein.
J. Eliri.
Jonglei.
J. Talodi.
Kassala.
Merowe.
Meshra El Rek.
Murrat.
Omdurman.
Renk.
Roseires.
Sennar.
Shendi.
Suakin.
Taufikia.
Tonga.
Wad Medani.
Wadi Halfa.
Wau.

Cadastral Surveys.

The cadastral survey of Halfa Province was completed in January. The method adopted has been to run a series of closed traverses about 20 kilometres up the river and 20 kilometres back along the opposite bank. New azimuths were observed for each traverse. The closing error allowed was 1 in 5,000. The traverse stations were about 500 metres apart, and were marked by iron pipes sunk into the ground. The traverse stations were then plotted on to kilometre squares on the $\frac{1}{2500}$ scale.

The boundaries of properties were next plane-tabled on to these sheets by native surveyors. The native surveyors, drawn mostly from the Gordon College and other Sudan schools, were organised into section camps of four plane-tablers under an Egyptian sub-overseer. The work requires considerable care, but the natives show an extraordinary aptitude for this kind of survey, and an

error of more than a metre in the very neat maps produced was rarely found. The areas were taken out once by the planimeter, and once by the sliding scale, and if the agreement was within $\frac{1}{30}$ of a feddan,* the mean was accepted as the true area of the plot.

The fields in Halfa average about five feddans each, but the work is complicated by the necessity of deducting the areas of the houses and compounds, which, in this province, are usually built on the properties themselves.

The cost of the work in Halfa has been greater than in any other part of the Sudan and amounts to about 12 piastres or 2*s*. 6*d*. per feddan. This high rate is due partly to the broken nature of the ground, resulting in odd shaped plots and numerous boundary pillars, and partly to the fact that it was necessary to map the houses, while the cultivation was very scattered.

The survey of Berber Province has progressed steadily, the same method being employed as in Halfa; the work, it it hoped, will be finished by the end of the year.

In the Gezira settlement difficulties have again delayed progress, but the old work, which still had to be finally passed before the areas were computed, has now been completed. Demarcation is proceeding in the Kamlin and Messelemia "Marakaz," and the end of the season should see some 400,000 feddans of field work completed. The system of minute squares renders it possible to commence detail work, whenever it is most urgently required, and it has been decided to carry the framework across to the White Nile.

On the White Nile, the triangulation, a series of quadrilaterals, has been continued as far as Kawa; traverses have been run nearly to Getaina, and detail work is now in hand. The latter can only be carried out at low Nile, and settlement difficulties have here also much delayed progress.

An English Inspector, Mr. Beran, has been appointed during the year to take charge of the surveyors and maps in those provinces where the cadastral survey has already been completed. The staff is now being collected in each province for keeping these maps up-to-date, recording sales of land, and making the yearly alterations necessary owing to the erosion of the river.

A surveyor has again been placed at the disposal of the Director of Agriculture and Lands for special work relating to concessions of Government land, and a second surveyor is now at work in the Dongola Province, laying out the land in five feddan plots, in connection with the scheme for the irrigation of the Korma basin.

It is unlikely that systematic cadastral survey will be undertaken at present in any other provinces and the staff is being gradually reduced.

The yearly measurement of "Ushur," the toll collected on the rain-crops, is a matter of considerable difficulty. Up to date this measurement has not been the province of the Survey Department. The matter is now under consideration, and it is hoped that it may be possible to devise some more satisfactory method than that at

* A feddan = a little more than an acre.

present in force. The difficulty lies in the fact that the same plot of land is rarely cultivated two years running, that the measurement must be made while the crop is still in the ground, and that the position and extent of the land brought under cultivation is entirely dependent on the rain and the inclination of the nomad Arab.

Town Surveys.

The surveys of Halfa, Berber, El Damer, Shandi, Gredanef and Songa have been completed.

Those of Rufaa and Omdurman are now in hand.

EAST AFRICA PROTECTORATE.

Governor	Lieut.-Col. Sir J. Hayes Sadler, K.C.M.G., C.B.
Director of Surveys	Major G. E. Smith, C.M.G., R.E.
Deputy Director of Surveys, Trigonometrical and Topographical Branch.	Captain G. S. Knox, R.E.
Deputy Director of Surveys, Cadastral Branch.	Mr. A. E. Townsend.
Assistant Directors of Surveys, Trigonometrical and Topographical Branch.	Lieutenant E. W. Cox, R.E., Lieutenant G. C. Williams, R.E., from 6th Nov., 1908.
Assistant Director of Surveys, Cadastral Branch.	Mr. T. H. Galbraith.

(i.) Staff.

The present staff of the Survey Department consists of :—

Superintending Staff.

Director of Surveys.	1 Clerk and Storekeeper. 1 Assistant Clerk.

Trigonometrical and Topographical Branch.

Deputy Director. 2 Assistant Directors.	5 Surveyors. Native Artizans.

Cadastral Branch.

Deputy Director. Assistant Director. 15 Surveyors. 2 Clerks.	2 Government Clerks. 2 Draughtsmen. 10 Indian Surveyors and Draughtsmen.

(ii.) The Work of the past Year.

Trigonometrical Branch.—Owing to sickness and other causes the Trigonometrical Branch has been very short handed, and the result has been a smaller output of work than may be expected under normal circumstances.

The work done has been to carry the major triangulation from the Athi River base, near Nairobi across the waterless Taru Desert to the coast at Mombasa, a distance of about 400 miles. This desert presented some difficulty in the way of organisation, but was successfully crossed without loss of life or time.

At Mombasa it was possible to compare the latitude and longitude as carried down from the Athi River base, with one fixed by the Admiralty many years ago. A check azimuth was also observed at Mombasa, the results of which are not yet ready for comparison.

From Mombasa about 70 miles northwards along the coast, and about 20 miles inland, both major and minor triangles were observed. The triangulation was often a matter of considerable difficulty, owing to the absence of prominent hills, the thickness of the vegetation, and also the haziness of the atmosphere. Hill tops held sacred by the natives as the abode of the spirits of their dead were avoided.

Summary of Work done.	1908–09.	1907–08.
Major Triangulation—		
Area in square miles	5,624	7,320
Average triangular error	1·07″	1·77″
Number of triangles	27	50
Number of stations	28	41
Azimuths observed	1	1
Minor Triangulation—		
Area in square miles	About 600*	3,610
Average triangular error	1·66″	2·51″
Number of triangles	8*	163
Number of stations	4	40
Intersected Points—		
Additional area covered in square miles ...	About 1,200	5,375

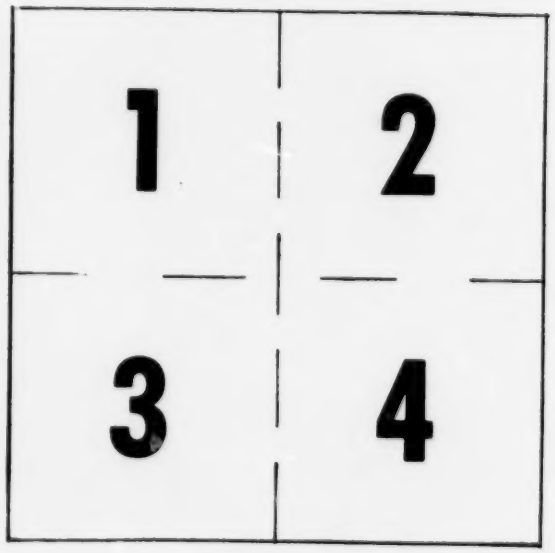
* Many of the major triangles are (owing to the physical character of the coast district) small enough to be used as secondary triangles.

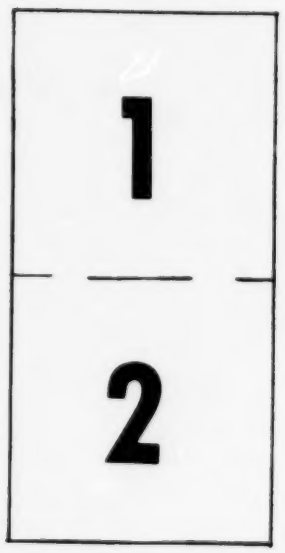
Topographical Branch.—This was only formed late in the year, and consequently there was little time to make much progress. A tertiary-triangulation covering two half-degrees sheets in the neighbourhood of Nairobi was completed, and a detailed survey of the country covered by these sheets is now being carried out on the $\frac{1}{12500}$ scale.

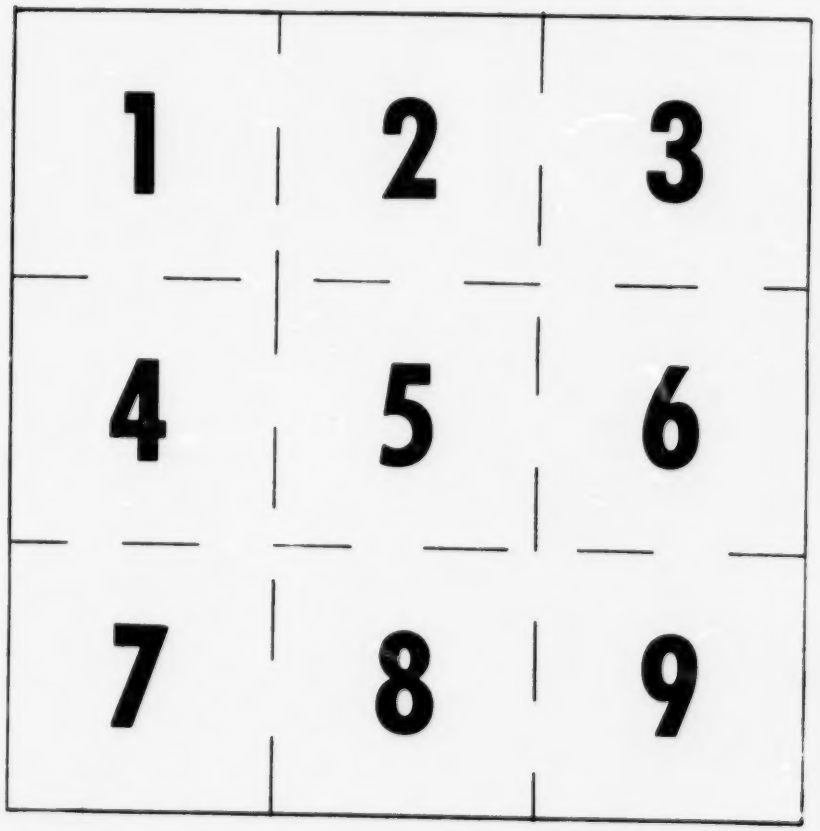
Owing to the great amount of detail in and near Nairobi, and the importance of this settled area, a sheet on the scale $\frac{1}{6250}$ is being mapped of the area :—

Latitude 1° 7′ 30″ to 1° 22′ 30″ S.
Longitude 36° 37′ 30″ to 36° 52 30″ E.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.

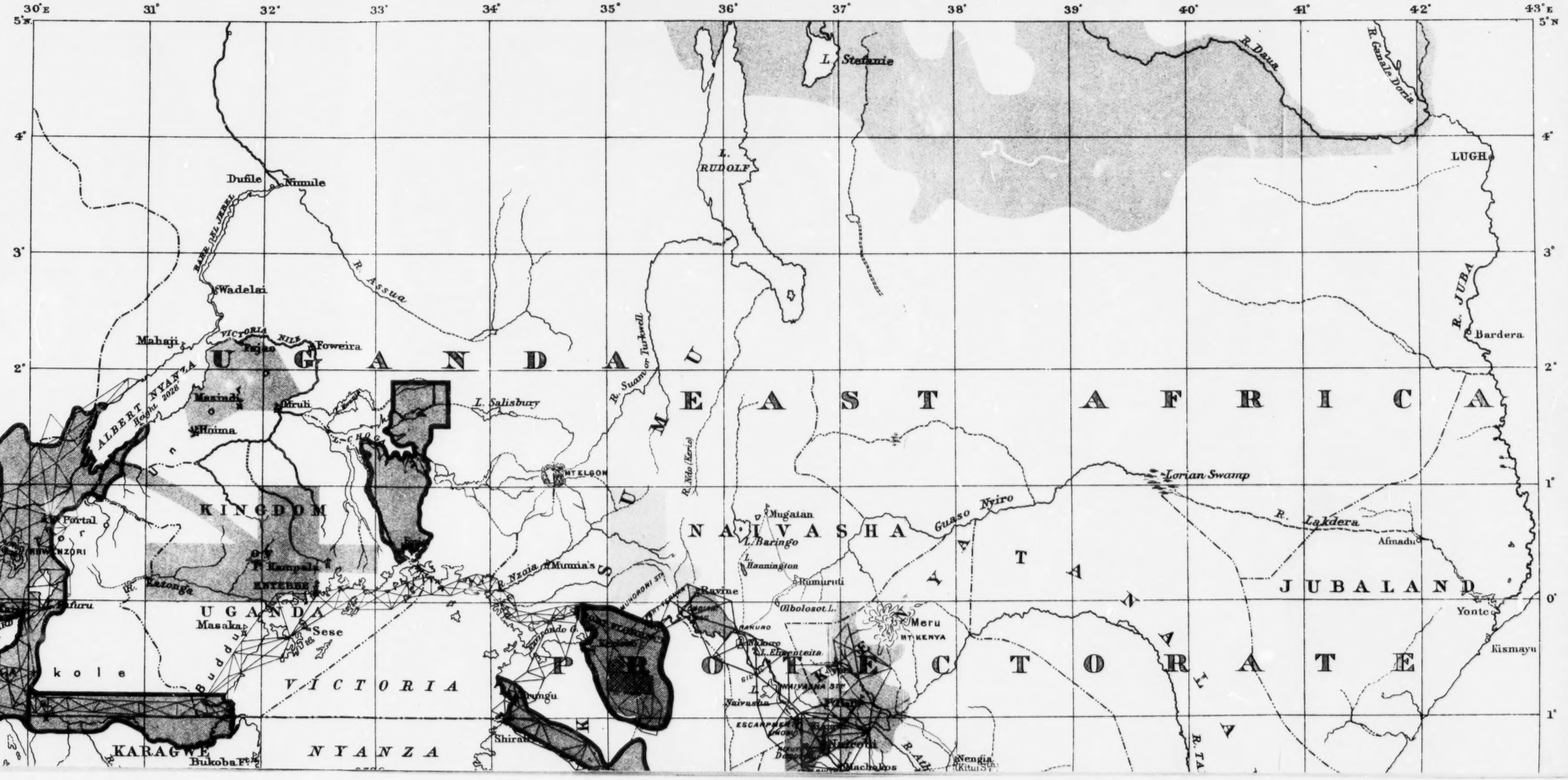






INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA



KINGDOM

UGANDA

PROTECTORATE

NANDI

NAIVASHA

JUBALAND

GERMAN EAST AFRICA

VICTORIA NYANZA 3720

L. KIVU

ALBERT EDWARD NYANZA 3000

Fortal

Kampala

Masaka

Sese

Buddu

Bukoba Ft.

KARAGWE

MFUMBIRO MT

R. Kagera

R. Mara

Shirati

Muanza

Olgos

Mugatan

L. Baringo

L. Hannington

Rumuruti

Guaso Nyiro

Lorian Swamp

R. Lakdera

Afmadu

Yonte

Kismayu

Olbolosot L.

Meru

MT KENYA

Nakuro

L. Elmenteita

Naivasha

Gilgil

Kikuyu

Escarpment

Dagoretti

Machakos Fort

Cable Bridge

Nengia (Kitui) Stn

R. Athi

R. Tana

Kapiti Plains Stn

Kiu

Machakos Road

Kibwezi

Tsavo R.

Jkutha (M.S.)

Witu

Lamu

L. Natron

Longido

Kilimanjaro

Mt Meru

Moshi

Taveta

Jipe

Voi-Taveta

Voi

Mwatate

R. Sabaki

Malindi

Takaungu

Rabai

Mazeras

MOMBASA

Wilhemstal

Vanga

Tanga

Pemba Id.

Pangani

Ujiji

Tabora

30° E 31° 32° 33° 34° 35° 36° 37° 38° 41° 42° 43° E

5° S 4° 3° 2° 1° 0° 1° 2° 3° 4°

REFERENCE

Telegraph lines

Railways Stn

Cart roads

Cleared (Trade) routes

Caravan tracks

Gov^t Stations

Topographical Section, General Staff; N^o 2291/a.

Topography completed in the field

Topography published

Triangulation completed

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

Revised June 1909

Uasin Gishu Plateau Rapid Allotment

Cadastral Surveys completed

The average triangular error of the tertiary triangles was six seconds.

Cadastral Survey.—The work for the year 1908–9 compares favourably with that of previous years. The official Surveyors were constantly in the field. The Licensed Surveyors were not employed so much as in former years, the reason being that most of the work was of an isolated character, and consequently, unremunerative; and the official staff was at liberty to undertake much of the work which was formerly given out to Licensed Surveyors. The rapid allotment scheme also contributed largely to the alteration in the state of affairs, as in former years such work would have been given to Licensed Surveyors.

A fair amount of topographic reconnaissance work to prepare for general laying out of farms was undertaken. An area, of roughly 200 square miles, was also surveyed for the Sleeping Sickness Commission.

A considerable amount of re-survey was done to re-establish missing or lost beacons. This was necessary owing to the beacons erected in the first instance having been unsubstantial, to their having been destroyed by fire or white ants, and in some cases fraudulently removed, and in other cases to their never having been erected by the Licensed Surveyors making the original survey; the department in the past being so under-staffed that any attempt at supervision was impossible. It is now considered that the only permanent type of beacon is one of angle iron 4 ft. high, set in concrete, such beacons costing roughly Rs. 7·50 each on the spot. Much money and valuable time would have been saved if this type of beacon had been adopted in the first instance.

Special note must also be made of the Jubaland surveys. These have been retarded, owing to the flooded state of the Juba River, and on this account no details can be given of actual work done, as nothing is yet completed; these surveys, however, will be completed early in the financial year 1909–10.

The cadastral map of the old town of Mombasa was completed during the year under review.

The standard of efficiency has been well maintained, the average error of closed traverses was 1 in 3,500, the closing error allowed being 1 in 2,000.

64 triangles were observed, the average triangular error being 6·4 seconds. The permissible error is 20 seconds per triangle. All triangles were observed by 5-inch micrometer theodolites.

The general average cost per acre compares favourably with last year's work.

Rapid Allotment, Uasin Gishu.—On the Uasin Gishu plateau 122 farms, representing 403,696 acres were set out during the past year, making with the 113 farms surveyed during 1907–8 a total of 235 farms beaconed and surveyed. The system of rapid allotment has been found to work well.

Detailed Statement of Farm Lands, Concessions and Building Plots surveyed April 1st, 1908, to March 31st, 1909.

Month.	Agricultural Areas.		Grazing Areas.		Fibre and Cotton Areas.		Reserves.		Provisional Surveys.		Building Plots.		Totals.	
	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.
1908.														
April	2	452	24	116,515	—	—	1	121	—	—	1	22	28	117,110
May...	—	—	—	—	3	94,523	—	—	—	—	3	294	6	94,817
June	13	3,302	5	91,120	—	—	—	—	—	—	136	651	154	95,073
July...	6	2,126	4	12,504	—	—	—	—	—	—	6	24	16	14,654
August	3	1,346	3	35,080	—	—	1	643	1	192,000	7	50	15	229,119
September	7	1,896	—	—	—	—	—	—	—	—	1	30	8	1,926
October	6	341	3	11,839	—	—	—	—	1	384,000	10	22	20	396,202
November	4	1,644	4	18,013	—	—	—	—	—	—	8	8	16	19,665
December	—	—	1	6,588	—	—	1	2	—	—	—	—	2	6,590
1909.														
January	1	640	7	19,856	2	125,120	—	—	—	—	1	1	11	145,617
February	2	460	—	—	—	—	—	—	—	—	1	5	3	465
March	7	722	8	39,643	—	—	—	—	—	—	—	—	15	40,365
Total	51	12,929	59	351,158	5	219,643	3	766	2	576,000	174	1,107	294	1,161,603

N.B.—The above does not include the rapid allotment surveys, nor the sleeping sickness area, Kisii.

Cadastral Surveys.

Comparative Annual Statement of Lands Surveyed, April 1st, 1908, to March 31st, 1909.

Year.	Class of Land.						
	Agricultural.	Grazing.	Forest and Rubber.	Fibre and Cotton.	Crown and Provisional.	Residential and Building	Total.
1904-5 ..	Acres. 49,740	Acres. 526,802	Acres. 10,000	Acres. 32,000	Acres. Details not extracted.	Acres.	Acres. 618,542
1905-6 ..	23,277	399,413	220,869	101,974	Areas included in totals.		745,533
1906-7 ..	9,667	519,914	64,320	276,366			870,267
1907-8 ..	16,106	504,737	12,946	188,474	138,125	2,372	862,760
1908-9 ..	12,929	351,158	—	219,643	576,768	1,107	1,161,603

Taking into consideration the difficulties met with owing to the losses, changes, and sickness in the staff, and the great delay and expense that is incurred in the field owing to want of good means of communication, the progress of the Survey Department during the past year may be said to have been very satisfactory.

EAST AFRICA.—ABYSSINIA BOUNDARY COMMISSION.

The Commission consisted of

British Commissioner	Major C. W. Gwynn, C.M.G., D.S.O., R.E.
Assistant Commissioner ...	Captain R. L. Waller, R.E.
Medical Officer	Captain Drake Brockman.
Transport Officer	Captain Condon.

Two R.E. Non-commissioned Officers.

The Commission was appointed in accordance with the provisions of the treaty with Abyssinia dated December 7th, 1907, and reached Dire Dawa in July, 1908.

Unfortunately owing to the illness of the Emperor Menelek no Abyssinian Commissioners were appointed and the British Commisioners had to act alone.

The Commission proceeded to the frontier *via* the Web River connecting the Ganale-Dawa junction by triangulation and a line of latitudes and azimuths with Adis Ababa, which latter place was also the origin of Captain Maud's survey 1902–3.

Working west, as the country was unsuitable for triangulation, the Dawa Valley and Garre plain were surveyed with measuring

wheel and compass. A route through the Marehan districts south of the Dawa and Eil Wak was also sketched. From the Boran highlands Captain Maud's triangulation was extended east and south and the frontier districts which lay rather outside this officer's work were re-surveyed.

The frontier with necessary modifications was beaconed from the Ganale-Dawa junction as far as Long. 38° 40′ E. Further west, with the exception of cairns constructed on the shores of Lake Stephanie, natural features were employed to define the line. From Lake Rudolf Captain Maud's triangulation was extended to the southern extremity of the Sudan frontier Lat. 60° N. Long. 35° E.

The Kibish Valley and the plateau west of it were surveyed with plane table, many points on Major Austin's and Bottego's routes being fixed.

The headquarters of the Commission returned *via* Kuffa to Adis Ababa where it was rejoined by a portion of the party which had returned direct from Lake Rudolf. Dire Dawa was reached May 10th, 1909.

In addition to the survey work on the frontier, a line of triangulation connecting Harrar and Dire Dawa to Adis Ababa was run and the country traversed was sketched with plane table.

Three lines of plane table survey were also run, chiefly through previously unexplored country between Adis Ababa and the southern frontier.

In all some 3,000 linear miles, averaging 10 miles in width, were surveyed.

THE GAMBIA.

No survey work has been carried out during the past year.

Major Cowie's map (1904–05) on the scale of $\frac{1}{250000}$ fulfils all immediate requirements. A reduction of this map on the scale of $\frac{1}{500000}$ has been prepared to illustrate a report on the Colony.

THE GOLD COAST.

Governor	... ...	Sir JOHN RODGER, K.C.M.G.
Director of Surveys	... ...	Captain E. F. W. LEES, R.E.

1. STAFF.

The staff of the Survey Department consists of :—

Director of Surveys. 2 Royal Engineer Surveyors.	3 Native Surveyors. 1 Native Draughtsmen. 1 Clerk.

The Work of the Past Year.

(*a*) *Trigonometrical work.*—None was executed.

(*b*) *Topographical work.*—The only topographical work done was the survey of some 150 square miles of country near Denjiassi.

(*c*) *Cadastral work.*—With regard to cadastral work, the following concessions were undertaken and completed :—

Kwatakye Concession.
Boabinso Concession.
Bondaye Concession.
Prah River Concession.
Chama Lagoon Concession.

The survey of the Tarkwa-Prestea Railway timber concession is also nearly completed.

A line was also cut across the Ebotokroo concession, and the south eastern boundary of the South East Concession, which had become practically obliterated, was recut.

The main feature of the year's work was the detailed survey of Accra on a scale of $\frac{1}{1250}$, or 104·16 feet to an inch, in six sheets.

When the rains commenced all the staff were concentrated in Accra, and the town survey was begun. The work proved arduous chiefly owing to the excessive heat; some 5,000 buildings and huts were measured of which very few were properly laid out, and, once away from the main streets of the town, it was very often impossible to see more than 20 feet.

The field work in connection with the Christiansborg and Victoriaborg surveys was also taken in hand, and a large portion of the latter has been plotted; when completed the whole survey will be contained in 14 sheets.

A $\frac{1}{5000}$ plan in two sheets, showing all the ground within the municipal boundaries of Accra was also commenced, and is about half finished.

In addition to the survey of Accra, a detailed survey of the village of Nianyano was taken in hand and completed.

(*d*) *Special work.*—The Bekwai-Adansi boundary, the beaconing of which had been found unsatisfactory, was properly defined.

The beaconing of the Government Reserve in Ashanti between the Anum and Prah Rivers was also carried out.

(*e*) *Map production.*—After handing over the Directorship in January, 1908, Major Guggisberg, C.M.G., R.E., remained in charge of the production of the map of the Colony (scale $\frac{1}{1250000}$) in London; this work was completed in August and is on sale.

Geographical Index.- An index giving the position of every town, village, river, &c., in the Colony was also compiled and is now on sale.

Ashanti.

Owing to the pressure of other work and other causes, little progress has been made with the map of Ashanti.

NORTHERN NIGERIA.

Governor	... ...	Colonel Sir PERCY GIROUARD, K.C.M.G., D.S.O., R.E.
Intelligence Officer	... ...	Captain H. N. KEMPTHORNE.

No survey work in the field has been done during the past year.

The compilation of a map of the Protectorate on the $\frac{1}{250000}$ scale is half completed. This compilation consists of a series of road sketches tied on the work of the Niger-Chad and Anglo-German Boundary Commissions, and also on the points fixed by Captain Ommanney's expedition.

The map will be published in 68 degree sheets; 33 of these sheets have now been compiled, of which one has been published, and 23, chiefly consisting of the work of Major O'Shee's Boundary Commission, are now in proof stage.

The compilation is now in charge of the Intelligence Officer, assisted by an officer of the West African Frontier Force temporarily attached, and one native draughtsman. This staff is being strengthened by the addition of one R.E. N.C.O., who embarked for Northern Nigeria in June, 1909.

A small scale map of the Protectorate on the $\frac{1}{2000000}$ scale has been recently compiled by the Intelligence Officer, and is now being reproduced.

Captain Kempthorne deserves great credit for the rapid progress of the compilation.

SOUTHERN NIGERIA.

Governor	... ...	Sir WALTER EGERTON, K.C.M.G.
Director of Surveys	... ...	Mr. E. P. COTTON.
Intelligence Officer	... ...	Captain W. H. BEVERLEY.

STAFF.

The staff of the Survey Department as authorised in the estimates for the current year, is :—

Director.
Deputy Director.
6 European Surveyors.
6 Native Surveyors.
1 European Draughtsman.
12 Native Clerks and Draughtsmen.
Learners, Messengers, and Labourers.

Owing to sickness and the necessarily liberal leave regulations the numbers at work at any time will always be short of the establishment. In May, 1909, for instance, the working staff was less than the above by two European surveyors, one native surveyor, and seven native clerks and draughtsmen.

Expenditure.

The estimated expenditure for the year under review was £12,359. Since 1905 liberal grants have been made to the Department; the total sum allotted during the three years 1907–09 inclusive amounts to somewhat more than £30,000; this expenditure does not include the cost of the Land Office.

Inspection.

Major E. H. Hills, C.M.G., was deputed to inspect and report upon the department. In his report, which is dated the 1st June, 1909, he points out that for an expenditure of £30,000 during the past three years and for a previous expenditure of £22,868 from 1901 to 1906 inclusive (during this period the land and survey departments were combined), the survey department has produced :—

(1) Property plans covering in all a small area, for legal, land office, railway, and other purposes, chiefly in the vicinity of Lagos.

(2) Contoured plans for Lagos water supply schemes.

(3) Large scale plans of varying degrees of precision of eight towns in the interior.

(4) A network of main traverse lines covering the Western Province, 1,900 miles in total length.

(5) A network of compass traverses covering about three-quarters of the above area.

(6) A network of barometer heights.

(7) A contour survey of an incomplete character covering about 13,000 square miles.

(8) The fixation of both astronomical co-ordinates of 55 points.

(9) Some hydrographical surveys carried out in conjunction with the Marine Department.

Maps of the Central and Eastern Provinces.

The work of the Survey Department has been confined to the Western Province. The exploration and mapping of the other provinces is being effectively prosecuted by Captain W. H. Beverley, the Intelligence Officer. These maps consist of a network of route surveys carried out by officers, adjusted to astronomical positions and certain accurate traverses executed by Captain Woodroffe and Lieutenant Moir.

Captain Beverley is doing good work and has produced a map of real value to both the civil and military authorities.

YOLA-CROSS RIVER BOUNDARY COMMISSION.

British Commissioners:

Lieutenant-Colonel G. F. A. Whitlock, R.E.
Captain H. T. G. Moore, R.E.
Lieutenant W. V. Nugent, R.A.
2nd Lieutenant W. D. Downes, Royal Sussex Regt.
Dr. Beale Browne, West African Medical Service.
Dr. Beatty, West African Medical Service,
with Lance-Corporals H. Locke, R.E., and E. F. Davies, R.E.

The Commissioners started work from Yola on 6th October, 1907, and surveyed the boundary line as far as Kwossa, 170 miles S.W. of Yola, where on 19th April, 1908, work was suspended for the rainy season. During this period the German Commissioners were:—

Major Haering,
Ober-leutnant von Stephani,
Ober-leutnant Rothe,
Ober-leutnant Cuno,

with Paymaster Arnold and Sergeants Buchholz, Schultze, and Glatte.

This portion of the boundary traverses bush country crossing, about 100 miles from Yola, the Shebshi Mountains, a range which rises to a height of 4,500 feet above sea-level, with several peaks, the highest of which is Vogel Spitz 6,700 feet above sea-level.

During the recess the British and German Commissioners returned to Europe, work being resumed on 19th October, 1908. For the second portion of the work the German Commissioners were:—

Ober-leutnant von Stephani,
Ober-leutnant Bartsch,
Ober-leutnant Rothe,
Leutnant Detzner.

Work was completed in April, 1909, at Boundary Post 5 of Captain Woodroffe's survey. The country traversed during the second season was very rough and mountainous until within 50 miles of Boundary Post 5, when it became undulating and covered with dense forest, the trees being for the most part 100 feet high.

From the middle of January, 1909, to the finish of the work, tornados with torrents of rain were of daily occurrence, and delayed the work. On the 16th April, 1909, the British and German Commissioners met at Bashu, Southern Nigeria, and after comparing maps, &c. agreed on the line (mean azimuth is 46°·44′ 27″ W. of S.) from the centre of Yola to the centre of the River Anybir in Southern Nigeria, and thence to Boundary Post No. 7 (Captain Woodroffe's survey) as a provisional boundary line, leaving the selection of a boundary with natural features for the consideration of the Home Governments.

The total length of boundary delineated was approximately 320 miles, while an area of nearly 4,000 square miles was accurately surveyed by triangulation and plane tabling.

Except at Sonkwala, which is about 80 miles north of the Cross River, all the natives were friendly. Here fighting took place on December 24th and 26th, the British and German escorts fighting side by side. Our losses were 5 killed and 19 wounded, among the latter being Ober-leutnant von Stephani, the German Commissioner, who was dangerously wounded.

NYASALAND.

Governor ... ... Sir ALFRED SHARPE, K.C.M.G., C.B.
Director of Public Works ... Mr. T. I. BINNIE.

(The Public Works Department undertakes the surveys.)

Topographical Work.—The only topographical work undertaken during the year was a small strip along the boundary between Zomba and Fort Maguire. The survey was made in order to have a path cleared along the whole boundary from Lake Chiuta to Lake Nyasa.

Cadastral Work.—Six estates aggregating 710 acres were surveyed and plotted during the year.

Miscellaneous.—Fifty miles of the Ruo and Shire rivers were surveyed in connection with the delimitation of the islands between Great Britain and Portugal.

The delimited Anglo-Portuguese boundary between Lake Chiuta and Lake Nyasa was marked out on the ground.

SIERRA LEONE.

Governor ... ... Mr. LESLIE PROBYN, C.M.G.

A general revision incorporating all new sketches, road traverses, &c., is being made of the $\frac{1}{250000}$ sheets of this Colony. This will shortly be ready for publication.

During the past year a small amount of triangulation has been carried out by Captain Nanson, R.A., and this has been made use of in the revision.

SOUTH AFRICA.

General Review of the Surveys.

The Survey Departments.—The Colonial Survey Committee is not concerned with the surveys of the South African Colonies, except in so far as Imperial interests are involved.

Each Colony has a Survey Department administered by a Surveyor-General.

These Survey Departments are, in effect, land record departments. The farms are surveyed by licensed surveyors and plans and records of the farms are kept in the Surveyor-General's office. The farm plans as a rule show only what is necessary for the definition of property boundaries; each farm is surveyed independently, and from the nature of the case little attention is paid to the delineation of the hill features.

The Surveyor-General of Cape Colony has been carrying out a small amount of secondary triangulation in the south-western districts of the Colony with the object of connecting up the farm surveys.

State of the Topographical Maps of South Africa.—The topographical surveys of Cape Colony and Orange River Colony have been steadily progressing during the past year. The geographical survey of Basutoland has been completed by Captain M. C. Dobson, R.F.A.

No topographical surveys have been carried out in Natal or the Transvaal. The total area topographically surveyed in the field during the past four years in the Cape Colony, the Orange River Colony, and Basutoland, amounts to about 113,000 square miles.

BASUTOLAND.

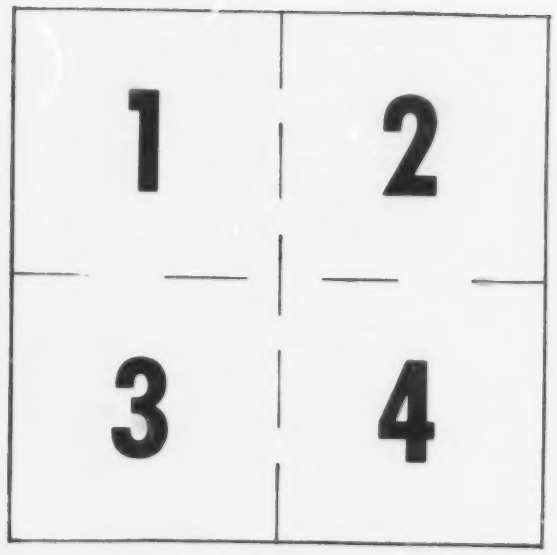
The reconnaissance survey of Basutoland has been completed during the past year by Captain Dobson, R.F.A. This survey, which embraces the whole of Basutoland and covers an area of about 10,000 square miles, has been in progress for the last four years and has been carried out single-handed by Captain Dobson in the face of considerable difficulties. This officer deserves great credit for his work. The map will be reproduced in degree sheets on the $\frac{1}{250000}$ scale. One of these sheets is already published.

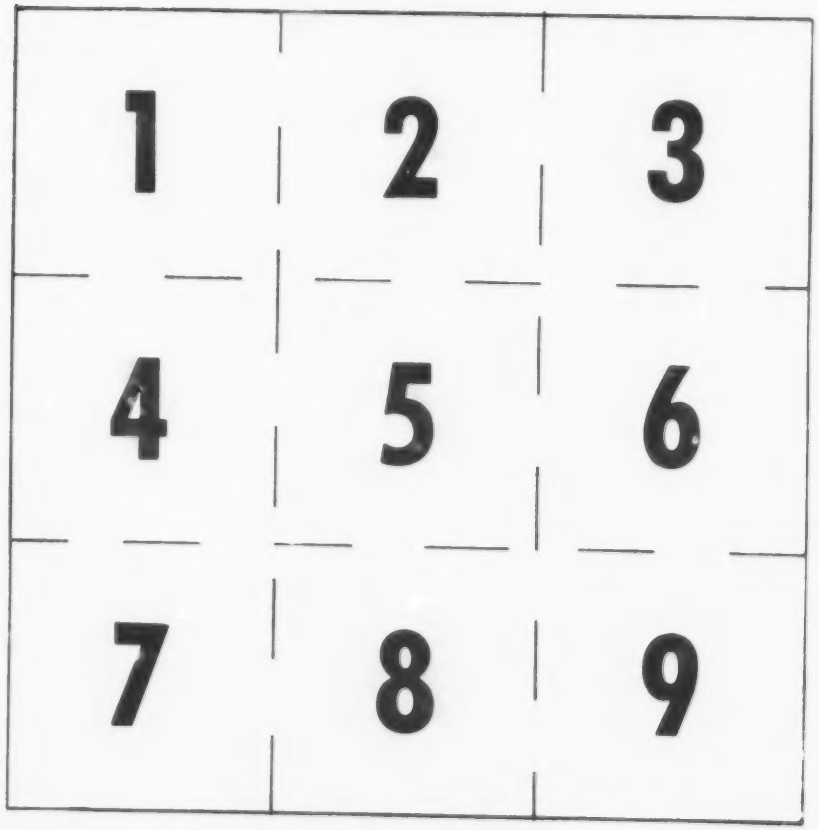
CAPE COLONY.

During the year the work of the reconnaissance surveys has made steady and excellent progress.

Since March 31st, 1908, an area of 14,500 square miles has been completed in the field. This brings the total area surveyed, since the commencement of the reconnaissance survey, up to 72,000 square miles.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





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SOUTH AFRICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

Miles 50 0 50 100 150 200 Miles

REFERENCE

Work in progress.....

Field sheets completed.....

Sheets published.....

Red names shew names of sheets

The map of the Orange River Colony will be published in district or half district sheets on the $\frac{1}{125,000}$ scale.

16° 17° 18° 19° 20° 21° 22° 23° 24° 25° 26° 27° 28° 29° 30°

22° 23° 24° 25° 26° 27° 28° 29° 30°

GERMAN SOUTH WEST AFRICA

BECHUANALAND

TRANSVAAL

ORANGE RIVER COLONY

NATAL

BASUTOLAND

127-E 127-F 127-K & 127-L

ORANGE RIVER MOUTH

STINKFONTEIN

PORT NOLLOTH

OOKIEP

WARMBAD 128-A

LITTLE BUSHMAN LAND 128-G

SCUIT DRIFT 128-B

PELLA

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KAKAMAS

128-C

YAGT KOLKS VLOER 128-I

UPINGTON 128-D

KENHART 128-J

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128-E

PRIESKA 128-K

Diep Fontein

Postmasburg Paapkuil 128-F

GRIQUATOWN

Campbell

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KIMBERLEY

129-G

JACOBSDAL

FAURESMITH

PHILIPPOLIS

Petrusville

Smithfield

SMITHFIELD

WEPENER

DENBURG

Edenburg

De Wetsdorp

Trompsburg

Fauresmith

Jacobsdal

Boshof

Brandfort

Winburg

Senekal

Ficksburg

Thaba Nchu

Ladybrand

MASERU

SEHONGHONG

129-J

129-K

129-L

Ladysmith

Colenso

Weenen

Bulwer

Richmond

Durban

P'MARITZBURG

GIANT'S CASTLE

BOSHOF

WINBURG

SENEKAL

HARRISMITH

BETHLEHEM

FRANKFORT

HEILBRON

LINDLEY

VREDEFORT

KROONSTAD

VREDE

Witkopjes

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Lindley

Vrede

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Sheet I

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LADYBRAND

Thaba Nchu

Bloemfontein

Ladybrand

Tabanchu

Dundee

Talana

Utrecht

Vryheid

Newcastle

Standerton

Volksrust

Wakkerstroom

Charlestown

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Ermelo

Bethal

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Marabastad

P.P. Rust

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Ohrigstad 128-A

Tylstroom 125-E

Nylstroom

Potgietersrust

Warmbad

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Magalakwin 121-Q

Palapye

Lotsani R.

N. Pongola Flats 121-V

Blaauwberg 121-W

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Olifants R.

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Klip R.

Pongola R.

Buffalo R.

Tugela R.

Umzinyati R.

Umkomaas R.

Umzimkulu R.

Umtamvuna R.

Kraai R.

Caledon R.

Groot Vloer

Groot Doorn Pan

Karkop

Onderstedoorn

Kenhart

Upington

Kakamas

Scuit Drift

Warmbad

Pella

Yagt Kolks Vloer

Little Bushman Land

Ookiep

Port Nolloth

Stinkfontein

Orange River Mouth

Griquatown

Strydenburg

Prieska

Vanwyks Vlei

Diep Fontein

Kimberley

Boshof

Hoopstad

Bloemhof

Vryburg

Taungs

Warrenton

Jacobsdal

Fauresmith

Philippolis

Petrusville

Smithfield

Wepener

Denburg

Edenburg

De Wetsdorp

Trompsburg

Maseru

Sehonghong

Ficksburg

Senekal

Winburg

Boshof

Brandfort

Thaba Nchu

Ladybrand

Bethlehem

Harrismith

Frankfort

Heilbron

Lindley

Vrede

Vredefort

Kroonstad

Standerton

Volksrust

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Ladysmith

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Underberg

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on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

0 50 100 150 200 Miles

REFERENCE

Work in progress.....

Field sheets completed.....

Sheets published.....

Red names shew names of sheets

The map of the Orange River Colony will be published in district or half district sheets on the 1/125,000 scale.

19° 20° 21° 22° 23° 24° 25° 26° 27° 28° 29° 30° 31° 32° 33°

22° 23° 24° 25° 26° 27° 28° 29°

BECHUANALAND

TH WEST
CA

TRANSVAAL

ORANGE RIVER COLONY

EAST AFRICA

PORTUGUESE

SWAZILAND

BASUTOLAND

NATAL

ZULULAND

Tuli
RHODES' DRIFT
ZOUTPANSBERG
PAFURI
Palapye
MAGALAKWIN
Louis Trichard
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BLAAUWBERG
LETABA
PIETERSBURG
LEYDSDORP
Marabastad
Mochudi
DERDEPOORT
KRANTZBERG
PYLSTROOM
GELUK
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UMBABAT
Lydenburg
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RUSTENBURG
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HEILBRON
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LINDLEY
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FICKSBURG
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KAKAMAS
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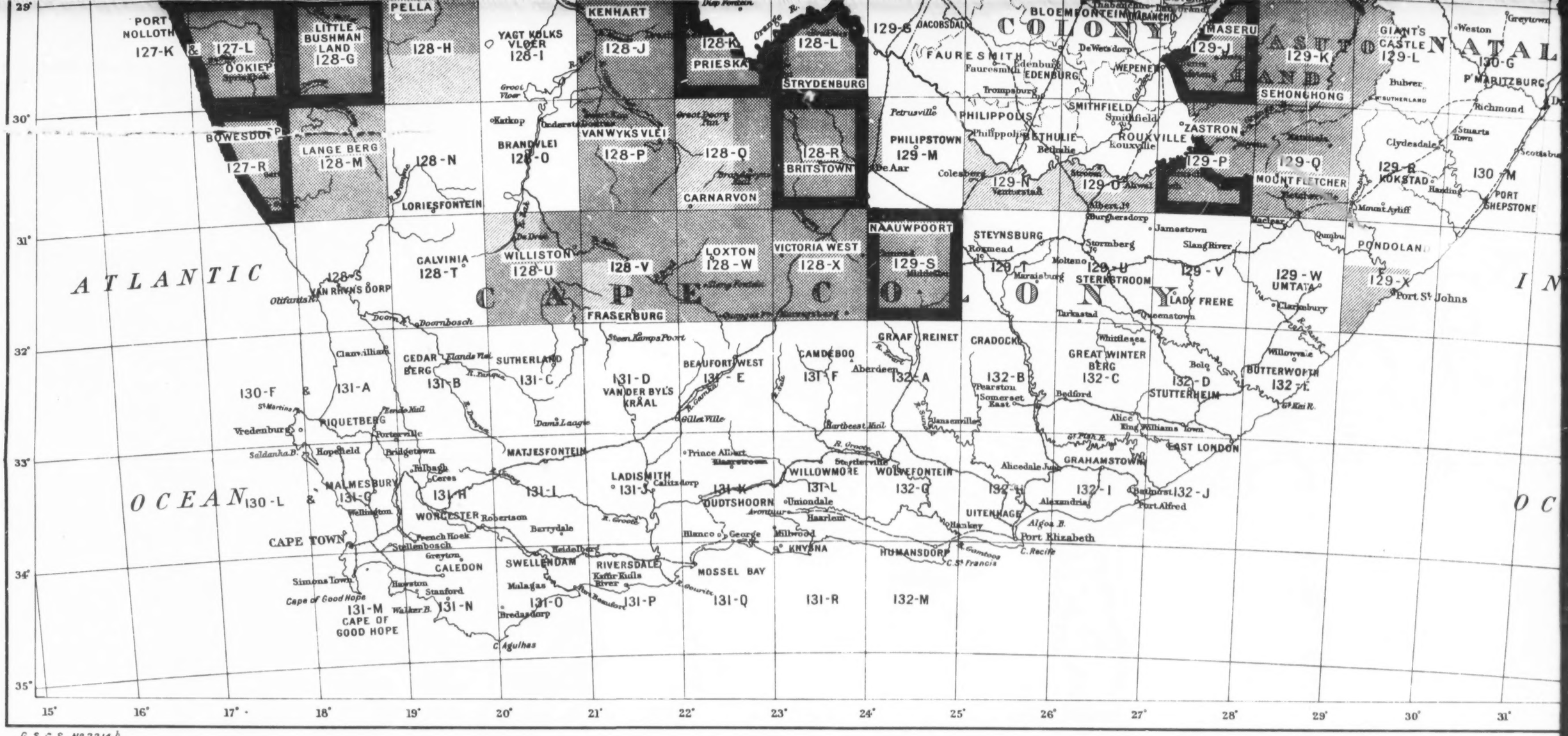
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Heidelberg
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Malagas
Bredasdorp
MOSSEL BAY
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Kei R.
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Umzimvubu R.
Umtamvuna R.
Umzimkulu R.
Umkomaas R.
Umgeni R.
Tugela R.
Umvoti R.
Umsinga
Estcourt
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Weston
P. MARITZBURG
Richmond
Bulwer
Clydesdale
Stuarts Town
Kokstad
Mount Ayliff
Matatiele
Maclear
Qumbu
Clarkebury
Willowvale
Elliotdale
Kentani
Butterworth
Idutywa
Bolo
Cathcart
Stutterheim
Komgha
Berlin
Bedford
Fort Beaufort
Adelaide
Bathurst
Grahamstown
Peddie
Kenton
Port Alfred
Alexandria
Uitenhage
Algoa B.
Port Elizabeth
C. Recife
Humansdorp
C. St Francis
Gamtoos R.
Knysna
Mossel Bay
George
Oudtshoorn
Uniondale
Willowmore
Wolvefontein
Graaff Reinet
Cradock
Aberdeen
Camdeboo
Beaufort West
Sutherland
Fraserburg
Victoria West
Loxton
Williston
Carnarvon
Britstown
Strydenburg
Prieska
Kenhart
Yagt Kolks Vloer
Pella
Port Nolloth
Ookiep
Bowesdorp
Lange Berg
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Porterville
Piketberg
Tarde Mail
Matjesfontein
Prince Albert
Klaarstroom
Ladismith
Calitzdorp
Oudtshoorn
Uniondale
Haarlem

Compiled in the Geographical Section, General Staff.

1906

AGENTS FOR THE SALE OF MAPS PUBLISHED BY THE GEOGRAPHICAL SECTION, GENERAL STAFF

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Price 1/- net

War Office, Revised June 1909

Twenty sheets have been completed in the field and of these 12 sheets on a scale of $\frac{1}{250000}$, representing an area of 32,000 square miles have been published and are on sale.

Three parties were employed, each consisting of one seconded and one temporarily attached officer with the necessary transport.

The seconded officers employed during the past year were :—

Captain H. S. P. SIMON, D.C.L.I.
„ C. W. GORDON, Northd. Fusiliers.
„ H. R. PAYZANT, Lan. Fusiliers.
„ A. C. H. JONES, Northd. Fusiliers.
Lieut. H. P. LITTLEDALE, K.O.Y.L.I.

The work was in charge of Captain G. F. Evans, R.E., until March, 1909, and is now in charge of Captain H. W. Gordon, R.E.

ORANGE RIVER COLONY.

The topographical survey of the Orange River Colony has continued to make satisfactory progress during the past year.

The total area mapped in the field since the commencement of the survey in December, 1905, amounts to 26,000 square miles, which gives a daily output of 21·02 square miles. During the past year 7,100 square miles of this total have been completed.

During the year under report the average triangular error was 2·1″. A chain of secondary triangulation 109 miles in length closed with an error of ·022″ in latitude and ·021″ in longitude. The Survey section has been working westwards, from the broken and rugged country along the north western Basutoland border, towards the western Orange River Colony frontier between Hoopstad and Kimberley. An exceptional rainfall caused considerable delay to the work.

The country now being mapped presents few difficulties and the daily output of work has in consequence risen. The northern half of the Brandfort degree sheet was completed at an average rate of 27·6 square miles a day.

The progress of this survey, which is now in charge of Captain H. St. J. Winterbotham, R.E., assisted by Lieut. A. G. McNeill, R.E., is very satisfactory.

RHODESIA.

The Surveyor-General of Southern Rhodesia has completed the compilation of a general map of Southern Rhodesia on the $\frac{1}{297504}$ scale based on the geodetic triangulation and farm surveys. This map is now being reproduced in 7 sheets on the $\frac{1}{500000}$ scale, and the majority of the sheets are nearing completion.

UGANDA.

(*Vide map facing p.* 20.)

Governor	... ...	Sir H. Hesketh Bell, K.C.M.G.
Director of Surveys	... ...	Mr. R. C. Allen.
Officer in charge of the Topographical Survey of Buganda.		Captain Macfie, R.E.

In accordance with the decision of the Secretary of State, the Survey Department has been relieved of all topographical work and is now able to devote itself entirely to the very important cadastral survey required by the Uganda agreement.

The topographical survey of Buganda was in February last taken over by a survey party consisting of two officers and six N.C.O.'s of the Royal Engineers, under the command of Captain W. C. Macfie, R.E. On this account the Survey Department was reduced by three surveyors and one draughtsman, and now consists of 12 European and one Indian surveyor, one European clerk, and three Indian clerks and draughtsmen.

(*a*) Work of the Survey Department.

Main Triangulation.—As anticipated in last year's report no further main triangulation was required during the year; the total area covered by this triangulation remains, therefore, at 7,594 square miles.

Secondary Triangulation has been completed and computed over an area of 950 square miles making the total area completed up to date about 7,520 square miles. Owing to very unfavourable weather with continued haze the average triangular error has been large, viz., 13·45 seconds.

Topographical Survey.—The area surveyed on a scale of $\frac{1}{125000}$ by two surveyors, working for six months, was 760 square miles. The country surveyed was extremely broken in character and food very difficult to obtain, and the results may therefore be considered satisfactory. The cost works out to £0 18*s.* 4*d.* per square mile.

The total area topographically surveyed to date is approximately 5,300 square miles, and the field work of four sheets of the $\frac{1}{125000}$ series, viz., 86 T. III, 86 T. IV, 86 U. I, and 86 U. III is now completed.

As stated above this branch of the survey has now been taken over by a special survey section.

Cadastral Survey.—The area over which theodolite observations were completed during the year was 632 square miles, making the total to date 1,412 square miles. Detailed survey was completed over an area of 608 square miles as compared with 293 square miles in 1907–08, making the total area surveyed cadastrally in Buganda 1,283 square miles.

The main reasons for this marked improvement in output are (*a*) the freeing of the Survey Department from extraneous surveys; (*b*) the determination not to withdraw surveyors from the cadastral survey even though the survey of Crown lands

has fallen into arrears; (*c*) the organisation of native labour by the Lukiko and Saza chiefs, and its employment under European control in the cutting of boundary lines of native estates. The value of the labour supplied gratis for the cutting of such boundary lines has been very considerable, as many as 800 or 900 men have been engaged simultaneously on this work representing a payment in labour by the natives of about £4 a mile. The future progress of the survey at the estimated cost depends on the continuance of this free labour supply.

A considerable number of miscellaneous surveys were also carried out during the year.

(*b*) The Topographical Survey of Buganda.

The R. E. survey section reached Entebbe on the 8th February, 1909.

The scale of the survey is to be $\frac{1}{250000}$, and the area to be surveyed after deducting those portions of which the topography has already been completed is about 25,000 square miles. It is hoped that the survey will be completed in two years at a cost estimated at £9,212.

(*c*) Surveys of the South, South-West and East Shores of Lake Albert.

The work of the Anglo-Congolese Boundary Commission covering an area of some 9,000 square miles was completed in April, 1908, and has been reproduced in five sheets on a scale of $\frac{1}{125000}$.

(*d*) Uganda Railway Extension Survey.

The surveys in connection with the extension of the Uganda Railway were completed during the year under Captain Stevenson, D.S.O., R.E., assisted by Lieutenant H. A. L. Hall, R.E. Amongst these an area of about 2,000 square miles on the $\frac{1}{250000}$ scale was surveyed in Bunyoro Province and another area of about 600 square miles was surveyed on the $\frac{1}{125000}$ scale in the Naiwasha Province of the East Africa Protectorate.

Lieutenant C. E. Fishbourne, R.E., assisted by two N.C.O.'s R.E. who had been engaged the previous year in mapping the region between Lake Victoria and Lake Choga extended his work to the north-east of the latter lake where he completed an area of 900 square miles during the past year.

This survey, which covers an area of about 3,400 square miles has now been reproduced on the $\frac{1}{125000}$ scale in five sheets in black only.

V.

THE STATE OF THE SURVEYS

OF

BRITISH HONDURAS, CEYLON, FEDERATED MALAY STATES, FIJI, JAMAICA, TRINIDAD.

BRITISH HONDURAS.

Governor	...	...	... Colonel E. J. E. SWAYNE, C.B.
Surveyor General	...	...	... Mr. H. J. PERKINS, I.S.O.

General Note.—The Governor reports that the only existing map of the Colony is a compilation, now 20 years old, by Mr. Usher. This was constructed from the hearsay information of travellers, and although a painstaking piece of work, is quite unreliable away from the coast. Much inconvenience is continually being caused by this state of affairs.

The Governor is considering the possibility of carrying out a systematic reconnaissance survey of the Colony. The need is a very real one now that so many enquiries are being made into the agricultural and forest resources of the country and that so many railway projects have been brought forward.

STAFF OF THE LANDS DEPARTMENT.

This consists of :—

Surveyor General.	1 Clerk.
Assistant Surveyor General.	1 Draughtsman.
4 Assistant Surveyors.	2 Apprentices.
1 Forest Officer.	

Cost.—The cost of the department for the year under review was $24,196.

Trigonometrical and Topographical Surveys.—No surveys of this nature have been carried out.

Cadastral Surveys.—The staff is almost entirely employed upon the revenue surveys of small detached blocks of land. There are considerable arrears. At the present moment there are 155 parcels of land of a total area of 15,072 acres awaiting survey. In addition there are many lengthy boundary lines between Crown and private lands to be run. 58·3 miles were cut and traversed through the bush in connection with the Stann Creek Railway.

Receipts from licences to cut timber, and rents, and sale of Crown lands, amounted to $18,726.

Maps.—No maps were published during the year.

CEYLON.

Governor	... ...	Col. Sir H. E. McCallum, G.C.M.G., R.E., A.D.C.
Surveyor-General	... ...	Mr. P. D. Warren, C.M.G.

Existing State of the Surveys.—During the year the Survey Department has been working on the lines suggested by Major E. H. Hills, C.M.G., in his report of the 6th June, 1907.

As regards topographical surveys the following areas had been mapped up to the end of February, 1909 :—

1″ Old Topographical Surveys, in which hill-features are not shown—nearly 18,000 square miles.

5″ Contour Surveys—about 160 square miles.

2″ New Contour Surveys, for reduction to 1″—about 420 square miles.

Organisation.—The Staff of the Survey Department during the past year consisted of :—

1 Surveyor-General.

1 Assistant Surveyor-General.

1 Superintendent of Trigonometrical, Meteorological and Observatory.

1 Superintendent of Applications and Western Province.

1 Superintendent of Topographical Surveys.

6 Superintendents of Surveys.

22 Assistant Superintendents of Surveys.

6 First Grade Surveyors.

13 Second Grade Surveyors.

7 Third Grade Surveyors.

5 Fourth Grade Surveyors.

80 Supernumerary Surveyors.

55 Temporary Surveyors.

Six non-commissioned officers, R.E., of whom one has since died, were despatched from England during the year to fill the post of Assistant Superintendent. Four additional non-commissioned officers are now being sent out.

At the beginning of 1909 the staff of civilian Assistant Superintendents was increased by five, and approval has now been given to a further increase of four, and to the appointment of an additional superintendent, in order to cope with the arrears of settlement survey work. Careful consideration is also being given to the question of improving the supply of men for the subordinate grades.

FEDERATED MALAY STATES.

High Commissioner ... ... Sir JOHN ANDERSON, G.C.M.G.
Surveyor-General ... ... Colonel H. M. JACKSON.

Organisation.—The Survey Department was re-organised in September, 1908, as a Federal Department for the control of all the surveys of the four states of Perak, Selangor, Negri-Sembilan and Pahang. The Surveyor-General appointed under this new organisation is Colonel H. M. Jackson, late R.E., who arrived in September 1908.

The Department now consists of three branches :—

(1) Trigonometrical Branch : Head Quarters, Taiping.

(2) Topographical Branch : Head Quarters, Kuala Lumpur.

(3) Revenue Survey Branch under four superintendents, one in each of the following places : Taiping, Kuala Lumpur, Seremban and Kuala Lipis.

Cost.—The cost of the Survey Department during the past year was about £76,000.

Trigonometrical Branch.—Observations were made at sixteen new and seven old stations of the Major Triangulation which crosses the state of Penang.

In the Minor Triangulation 63 stations were fixed and in connection with these some 10,000 chains of standard traverse were completed, having an average closing error of 1 in 30,000.

For the assistance of the Topographical Survey some 826 miles of subtense work were carried out.

Topographical Branch.—This branch has only recently come into existence and up to the present no systematic survey has been commenced.

A considerable amount of topographical detail of varying degree of accuracy has been accumulated by both the Trigonometrical and Revenue Departments in the course of their own work. This is now being put into the proper form for assisting the coming systematic survey.

It is proposed to execute this survey on a scale of 2 inches to the mile and two surveyors have been trained in the methods adopted for this type of work in the Survey of India Department.

Revenue Branch.—All survey in this branch has been undertaken on "application," and consequently there has been no continuous "Cadastral" survey made.

The changes initiated under the new schemes of organisation are :—

(1) Uniformity in the preparation of "certified" plans, and in the compilation of the maps which will eventually form the "standard" sheets of the Revenue Survey.

(2) The substitution of a more vigorous method of survey to facilitate the issue of "grants."

The standard scale for all the future cadastral sheets has been laid down as four chains to the inch, except in special districts.

Maps.—The following maps have been published during the past year:—

(*a*) A general map of Negri-Sembilan on a scale of two miles to the inch.

This was compiled from all available data by the Trigonometrical Branch and was reproduced, together with a reduction on half the scale, by the Ordnance Survey, Southampton.

(*b*) Forty sheets of the Revenue Survey on a scale of 16 chains to the inch have been produced by the Superintendent of Revenue Survey, Perak. About half of them are revisions of former published sheets.

(*c*) A map of the Federated Malay States on a scale of 20 miles to the inch has been published by the Perak Revenue Survey Office.

Instruction.—An effort is being made to train lads (Tamil and Malay) for the Survey Department, and the first class of 14 has assembled at the Technical School, Kuala Lumpur.

FIJI.

Governor	Sir Everard im Thurn, K.C.M.G., C.B.
Commissioner of Lands	Mr. Dyson Blair.
Officer in Charge of the Trigonometrical Survey.	Captain C. H. Ley.

(1) Origin of the Trigonometrical Survey.

The Commissioner of Lands recommended the execution of a first class triangulation on which to base land surveys. The Governor approved, and the survey was sanctioned in August, 1908.

Captain C. H. Ley was put in charge of the work, which was estimated to last for two years, and to cost not exceeding £4,000.

Mr. T. Rimmer was appointed to assist Captain Ley.

(2) Country.

Viti Levu is an island about 4,112 square miles in area, and consists of a crumpled mass of hills rising to 4,500 feet above the sea, covered with dense forest. One road alone exists which crosses the island for the most part along the Rewa River. There are a few coast roads besides, but the interior is otherwise traversed by native forest tracks alone. The top slopes of the hills are very steep, whilst innumerable streams have cut the lower slopes into a network of ravines filled with densest vegetation.

Carriers are the only means of transport in the interior. Round the coast a cutter has been usefully employed. The main difficulty in this special work is for the Europeans to keep in health for a sufficient period to carry a line of triangulation through the interior, where, except the native vegetables, no food is to be obtained. Paths have generally to be cut to the hill tops, and a clearing of the summits before a round of angles can be taken is, as a rule, a laborious task.

(3) Transport.

It may be possible to effect an economy by organising some form of pack transport in place of the existing carriers.

(4) Maps.

Besides the Admiralty charts, the only existing maps are I.D.W.O. 1844, scale 11½ miles to one inch, and two original maps available locally, which were provided by the Lands Department.

Work in the field was commenced on 26th October, 1908, and continued till 2nd March, 1909, when the rains broke.

The following is a summary of the work completed:—

(*a*) Measurement of a base of 15,000 feet long at Navua, with a probable error of 1 in 340,000.

(*b*) Reconnaissance and marking of the base extension figure.

(*c*) Observation of a quadrilateral with a mean triangular error of 1·66″.

(*d*) One month's tidal observations for determining the mean sea-level datum.

(a) *Base Measurement.*—The preparation of the base occupied three weeks, and the measurement in two directions, 17 days. The swampy nature of the ground caused difficulty in fixing the terminal points of the base and in erecting beacon marks. A base measuring apparatus purchased from Messrs. Stanley consisted of:

(1) 2 optical transferring instruments on tripods.

(2) 2 straining tripods.

(3) Nine intermediate supporting tripods.

(4) One 100-foot Invar tape tested on the flat at Kew in August, 1907.

(5) One 100-foot Invar tape tested in the catenary at Southampton in August, 1908.

Tape (4) was used only as a standard for comparison. Reliable ground points could not be fixed owing to the boggy nature of the ground, and the two tapes were accordingly compared with each other before and after each of the two base measurements. Some small kinks had developed in the measuring tape, which had to be sent back to England to be re-standardised.

The base measurement party consisted of three white men and 11 natives.

The effect of friction on the supporting tripods was very marked. It was found, however, that this could be eliminated by taking a series of six readings at each setting; three being taken in each direction with the friction acting in opposite directions during each of the two sets of three readings.

The difference between the two measurements of the base (150 tape lengths) was 0·133 feet.

(c) Observations.—All observations at the main stations are made with a 6 inch theodolite (by Troughton and Simms). Owing to the extreme damp, the condensation on the object glass and eye-piece lenses of the microscopes rendered frequent cleaning of these necessary, and this necessitated constant adjustments for run which caused delay.

Observations were made on both faces, on five Zeros, at each station.

The probable error of a single angle works out to ± 0″·61.

(6) Miscellaneous.

Captain Ley reports that the effect of damp and mildew was so damaging to plane table sketches in these forest-covered hills that plane tabling was abandoned in favour of the field book.

The coefficient of refraction from four sets of reciprocal observations was found to be 0·21.

High and low water-marks were continuously observed from February 10th to March 10th and the greatest range was found to be 6·05 feet and the smallest 1·87 feet. The mean value for the height of a datum point on the pier above the sea is 5·310 feet. From this point levels were run to the base line, which is at a mean height of 4 feet above the sea.

JAMAICA.

Governor ... ... Sir Sydney Olivier, K.C.M.G.
Surveyor-General ... ... Mr. C. Liddell.

Staff.—The staff of the Crown Lands Department consists of:—

Surveyor-General.
2 Assistant Surveyors.
2 Clerks.
2 Temporary Clerks and Typists.
50 Crown Lands Bailiffs and Headmen.

Duties.—The duties of the department are almost entirely those of a lands department, and consist of the management of 200,000 acres of land, collection of rents, definition of boundaries, recovery to the Crown of lands occupied by squatters, and similar duties.

Cost.—The cost of the department for the year 1908–09 was £2,478. This is exclusive of the cost of the purchase of lands in Kingston for public buildings and streets, which amounted to £12,841.

Trigonometrical and Topographical Surveys.—Nothing of this nature has as yet been undertaken by the department.

Cadastral Surveys.—The work consisted of the survey of land forfeited to the Crown for non-payment of taxes. The surveys were all closed traverses with closing errors of from 3 to 7 links per mile. The total lengths of the traverses carried out during the year was 37½ miles.

Receipts.—The receipts from sales, rents, and miscellaneous sources, amounted to £4,003, or £1,525 more than the expenditure.

Maps.—The central sheet of the Cadastral Map of the parish of St. Catherine, covering about 170 square miles, has been revised and re-drawn to a scale of 4 inches to 1 mile.

TRINIDAD.

Acting Governor	Mr. S. W. KNAGGS, C.M.G.
Engineer in charge of surveys ...	Mr. C. S. COCHRANE, B.A.
Superintendent of Trigonometrical Survey.	Mr. E. R. SMART.

Staff.—The staff of the Survey Department consists of :—

Engineer in charge of Surveys.
2 Assistants.
4 Draughtsmen.
1 Clerk.
Officer in charge of Trigonometrical Survey.
3 Assistants.

Expenditure.—

	£
Survey Department	9,080
Trigonometrical Survey ...	2,400
Total	£11,480

Organisation.—The Department is divided into two branches, of which one is the Trigonometrical Survey Branch and the other is employed on the survey of Crown Lands. In the majority of cases the actual survey of lands petitioned for is entrusted to the sworn surveyors of the colony, of whom there are about 17.

The officers of the Trigonometrical Survey Branch are not on the fixed establishment.

General Remarks.—The trigonometrical branch has not been employed solely upon trigonometrical work. Since April, 1901, when the branch was formed, until April, 1907, nearly half of the expenditure was upon detail surveys and cadastral surveys. From April, 1907, to April, 1908, the trigonometrical branch was employed solely upon cadastral surveys.

This affords only a partial explanation of the very large expenditure upon the trigonometrical survey of the island. This work has cost, up to April, 1909, no less than £20,420, and is estimated to cost £6,000 to £8,000 more. It is to be noted that this survey is dealing with an island only 1,754 square miles in area, and that in addition to the sum just mentioned there is a large annual sum allotted for the survey of the Crown lands.

A matter which requires attention is the use of the magnetic compass in the execution of main traverses. The results seem to have been surprisingly accurate, but the departure from normal methods would appear to be unwise.

Maps.—During the year several sheets of the districts in which the Trigonometrical work has been completed, have been published.

VI.

GEODESY.

Measurement of an Arc of Meridian to the West of Uganda.—The measurement of this portion of the great African arc along the meridian 30° E. was begun in March, 1908, and completed in February, 1909.

The arc measured extends from 1° 10′ N. to 1° 10′ S., a distance of about 165 miles.

The work was organized by Major Bright, C.M.G., and was carried out by a party consisting of :—

British.	Belgian.
Capt. E. M. JACK, R.E.	Dr. M. DEHALU.
Mr. G. T. MCCAW.	Capt. WANGERMEE.
Mr. C. CHEVALLIER.	
Lce.-Corpl. JONES.	
Lce.-Corpl. PAGE.	

and for a portion of the time Capt. S. IREDELL, K.A.R. (commanding escort).

Cost.—The total cost to British funds was about £4,770, of which £1,400 was contributed by the following societies :—the Royal Society, the Royal Geographical Society, the Royal Astronomical Society, and the British Association for Advancement of Science.

Base.—One base of 16,532 metres in the Semliki Valley was measured by means of six invar wires, three of which were used as reference wires and the remainder for the field work. The actual measurement of this base occupied 38 days. The whole length was divided into 17 sections, each about one kilometre in length.

Invar wires, 24 metres long, were used and were suspended from tripods at a tension of 10 kilogrammes. Each space was measured with two wires, three readings being taken on each wire. When the range exceed 0·33 m.m. a fourth reading was made.

The whole base was measured once in each direction and the field wires were compared with the reference wires on a test base 120 metres long. This comparison was made three times—(1) before commencing the main base; (2) after completion of the first measurement; (3) after completion of the second measurement.

Triangulation.—The main chain of triangulation lies between the meridians of 30° 7′ and 30° 33′ E. This chain consists of 35 triangles in five figures, as follows:—one tetragon, three quadrilaterals, and one complex figure.

16 stations have been fixed, permanently marked, and their positions notified to the government of Uganda.

The angular measurements were made with two 10-inch Repsold theodolites. Luminous signals were used. These were furnished during the day by 5 inch heliographs and at night by acetylene lamps with projection attachment. In clear weather these lamps could be observed with facility up to 40 miles with a theodolite. Vertical angles were observed at all stations, from three to six measures being taken on different days.

From the preliminary calculations of the first four figures of the triangulation the probable error of an observed angle appears to be about 0·4″.

In addition to these angular measurements the following astronomical and magnetic observations were made by Dr. M. Dehalu.

(*a*) Fourteen latitudes.

(*b*) Three azimuths.

(*c*) Magnetic observations for declination and dip at 30 stations.

CLASSIFIED LISTS OF THE STAFFS OF THE SURVEY DEPARTMENTS.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	EAST AFRICA.				
	Superintending Staff.				
Director of Surveys	Major G. E. Smith, C.M.G., R.E.	800	... ...	3 years	—
Clerk and Storekeeper ...	Mr. A. Rehm	250	... ...	... ...	4th Jan., 1906.
Assistant Clerk	Mr. E. Rehm	72	... ...	... ...	1st Jan., 1909.
	Trigonometrical Branch.				
Deputy Director of Surveys ...	Capt. G. S. Knox, R.E. ...	667	... ...	3 years	16th March, 1906.
Assistant „ „ ...	Lieut. E. W. Cox, R.E. ...	525	... ...	„	16th March, 1906.
„ „ „ ...	Lieut. G. C. Williams, R.E. ...	525	... ...	„	6th Nov., 1908.
Surveyor	Corpl. W. Macdonald, R.E. ...	215	... ...	„	28th April, 1906.
„	L.-Corpl. M. Bracken, R.E. ...	215	... ...	„	20th Jan., 1909.
„	L.-Corpl. J. Rimmer, R.E. ...	215	... ...	„	20th Jan., 1909.
„	L.-Corpl. H. Thornton, R.E. ...	200	... ...	„	15th July, 1908.
„	L.-Corpl. J. Durkan, R.E. ...	200	... ...	„	15th July, 1908.
	Cadastral Branch				
Deputy Director of Surveys ...	Mr. A. E. Townsend	500	... ...	3 years	28th Dec., 1908.
Assistant „ „ ...	Mr. T. H. Galbraith	400	... ...	„	28th Dec., 1908.
District Surveyor	Mr. J. P. Clark	380	... ...	„	1st April, 1907.
„ „	Mr. J. T. Stiles...	360	... ...	„	28th April, 1908.
„ „	Mr. F. H. Jordan	360	... ...	„	1st March, 1909.
Senior Staff Surveyor ...	Mr. L. H. Lloyd	320	... ...	„	1st April, 1907.
„ „ „ ...	Mr. G. Woodruff	320	... ...	„	21st July, 1906.
„ „ „ ...	Mr. W. Nightingale	320	... ...	„	1st April, 1907.
„ „ „ ...	Mr. F. M. Lamb	320	... ...	„	31st May, 1907.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	EAST AFRICA—*continued.*				
	***Cadastral Branch*—continued.**				
Junior Staff Surveyor ...	Mr. E. K. Boileau	250	... ...	3 years	10th July, 1908.
" " " ...	Mr. A. Bessler	250	... ...	"	3rd Sept., 1908.
" " " ...	Mr. J. Marsengo	265	... ...	"	10th Nov., 1906.
" " " ...	Mr. J. Spalding...	265	... ...	"	31st May, 1907.
" " " ...	Mr. D. G. Crofts	265	... ...	"	27th Sept., 1907.
Chief Draughtsman	Mr. C. Panting	200	£40 house allowance	"	14th Sept., 1906.
Chief Accountant	Mr. E. W. Nicholls	150	" " "	2½ years	7th Jan., 1909.
Assistant Accountant... ...	Mr. W. T. West	140	" " "	3 years	4th July, 1908.
Draughtsman	Mr. D. E. W. Ashe	160	... ...	Temporary	14th Feb., 1909.
Assistant Junior Staff Surveyor.	Mr. H. C. Anderson	100	... ...	3 years	5th August, 1909.
10 Indian Surveyors and Draughtsmen.	... ...	713 (total for the 10 men).	... ...	Temporary	—
2 Native Assistant Surveyors	Vacant	48 (total for 2 men).	... ...	"	—
Clerk, Goanese...	S. X. Pinto	72	... ...	"	18th Sept., 1907.
" "	A. J. de Mello	64	... ...	"	1st Dec., 1906.
	GOLD COAST.				
Director of Surveys	Capt. E. F. W. Lees, R.E. ...	700	£140 duty allowance, £36 horse allowance.	Pensionable. 3 years on probation.	4th Jan. 1908.
Chief Surveyor	L.-Corpl. G. V. Mathieson, R.E.	250–10–300	£36 horse allowance.	" " "	4th Jan., 1908.
Surveyor	2nd Corpl. C. N. Kilby, R.E....	250–10–300	Horse allowance £36	" " "	4th Jan., 1908.
"	L.-Corpl. A. J. Jones, R.E. ...	250–10–300	" " "	... ...	19th June, 1909.

1 Native Surveyor	Mr. J. B. Esuwan-Gwira ...	200–10–250	£9 bicycle allowance	3 years on probation. Pensionable.	1 Jan., 1908.
2 Native Assistant Surveyors (2nd Class)	Mr. E. J. Smith ...	120–5–150	" " "		
	Mr. T. H. Vaughan ...				
1 Native Draughtsman ...	Mr. R. Josiah	120–5–150	" " "		
1 4th Grade Clerk	Mr. A. F. Benson	60–5–80	... ...		

NYASALAND.

Director of Public Works and Survey.	Mr. T. I. Binnie	450–600, by £25.	£100 personal ...	Permanent	15th March, 1897.
Assistant Surveyor	Mr. T. J. Firr	325–425, by £20.	£12 10*s.* electric light.	"	26th April, 1902.
" "	Mr. J. Bannerman	325–425, by £20.	" " "	"	1st June, 1901.
" "	Mr. G. N. Beaumont	200–300, by £10.	" " "	Temporary agreement...	5th Dec., 1905.
Clerk	Mr. E. Taylor	200–300, by £10.	£20 subsistence ...	... ...	6th July, 1906.
"	Mr. H. R. Cruise	"	" " ...	... ...	25th Oct., 1906.

SOUTHERN NIGERIA.

Director of Surveys	Mr. E. P. Cotton	700	£100 duty allowance	Pensionable	29th Oct., 1906.
Deputy Director of Surveys...	Mr. A. Cleminson	400–500, by £20.	£100 duty allowance	"	29th Oct., 1906.
Senior Surveyor	Mr. D. R. Meldrum	400	£80 duty allowance	"	13th March, 1909.
2 Surveyors	Mr. F. W. H. Black ...	390	... ...	"	23rd Sept., 1905.
	Mr. R. A. Webb ...				
3 Temporary Surveyors	Mr. R. L. Drouyn ...	350	... ...	Non-pensionable, by agreement.	13th Oct., 1906.
	Mr. E. N. Thomas ...		... ...	" " "	16th May, 1908.
	Mr. J. Scott		... ...	" " "	6th June, 1908.
Draughtsman ... ... *A.*	Mr. I. Sweney	350	... ...	" " "	13th Feb., 1909.
European Instructor, Survey School.	Mr. F. Hole...	450	... ...	" " "	17th Feb., 1909.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	UGANDA.				
	Cadastral Survey.				
Director of Surveys	Mr. R. C. Allen...	500–700, by £25.	... ...	... ...	30th Nov., 1900.
Deputy Director of Surveys...	Mr. W. V. Morris	325–425, by £20.	... ...	... ...	27th July, 1902.
Senior Surveyor	Mr. E. Richardson	360–20–400	... ...	3 years' agreement (Re-engaged for 3 years).	8th April, 1904.
,, ,, ...	Mr. E. G. Fenning	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
,, ,, ...	Mr. L. R. Fraser	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
Junior Surveyor	Mr. A. Richardson	300	... ...	3 years' agreement (Re-engaged for 30 months).	1st June, 1903.
,, ,, ...	Mr. J. T. W. S. McGregor ...	300	... ...	3 years' agreement (Re-engaged for 3 years).	17th July, 1903.
,, ,, ...	Mr. H. Boazman	350	... ...	3 years' agreement (Re-engaged for 30 months, 12/2/07).	17th July, 1903.
,, ,, ...	Mr. J. P. Tolland	300	... ...	3 years' agreement from date of arrival in Africa (not reported).	—
,, ,, ...	Mr. A. H. Gee	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. R. J. Goulston	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. V. F. Mayne	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. W. A. Khan	?	... ...	,, ,, ,,	—

UGANDA.

Topographical Survey.

Name.	Salary.	Allowances.	Tenure of Appointment	Date of present Appointment.
Capt. W. C. Macfie, R.E.	£ 667	£50 charge allowances	2 years	30th Dec., 1908.
Lieut. H. L. D. Pennington, R.E. ...	526	—	„	30th Dec., 1908.
Lce.-Corpl. J. H. Laverack, R.E. ...	11*s.* 1*d.* per diem, inclusive of allowances	—	„	30th Dec., 1908.
„ H. O. Jones, R.E. ...	„ „ „	—	„	30th Dec., 1908.
„ W. J. Whitters, R.E. ...	„ „ „	—	„	30th Dec., 1908.
„ W. McDiarmid, R.E. ...	„ „ „	—	„	30th Dec., 1908.
„ W. Richardson, R.E. ...	„ „ „	—	„	30th Dec., 1908.
„ Gee, R.E.	„ „ „	—	„	5th June 1909.

FEDERATED MALAY STATES.

Names.	Appointment.		Date of first appointment.	Salary of present appointment.	Actual salary.
	Pensionable.	Non-pensionable.			
Col. H. M. Jackson (late R.E.)	Surveyor-General	—	28th Aug., 1908...	£ 1,200	£ 1,200
	Trigonometrical Branch.				
Mr. A. E. Young	District Surveyor-General	—	28th June, 1892...	780–900	840
Mr. W. A. Wallace	Assistant Superintendent	—	8th Feb., 1904 ...	480–540	480
Mr. F. R. Twiss	" "	—	21st June, 1906...	480–540	480
Mr. V. A. Lowinger	—	Surveyor (on agreement)	10th Aug., 1906...	420	420
Mr. N. F. J. Haszard... ...	—	"	27th Aug., 1906...	420	420
Mr. J. Mouat	—	"	27th Aug., 1906...	420	420
Mr. R. Goulding	—	"	25th May, 1907 ...	420	420
Mr. A. Cochrane	—	"	30th Nov., 1907...	420	420
	Topographical Branch.				
Mr. E. W. Hedgeland ...	Assistant Superintendent	—	3rd Jan., 1907 ...	540–660	540
Mr. J. N. Sheffield	" "	—	14th Sep., 1896 ...	480–540	480
	Revenue Survey Branch.				
Mr. J. P. Harper	Superintendent	—	2nd Sep., 1889 ...	660–780	780
Mr. G. M. Stafford	"	—	29th Oct., 1889 ...	$ 3,000–4,200	$ 4,200
Mr. H. R. Shaw	"	—	27th June, 1890...	£ 660–780	£ 780
Mr. A. F. Harper	Assistant Superintendent	—	25th Mar., 1887...	480–540	540
Mr. E. G. Wood	" "	—	21st Dec., 1889 ...	480–540	540

						$
Mr. W. T. Wood	Assistant Superintendent (Office) ...	—	1st Jan., 1890 ...	—	3,600	
				£	£	
Mr. S. T. Debney	„ „ (Acting Superintendent).	—	1st June, 1890 ...	480–540	540	
Mr. E. J. Kemplen	Assistant Superintendent (in charge Kinta District).	—	18th Dec., 1891 ...	480–540	540	
Mr. J. G. K ch	Assistant Superintendent	—	8th Jan., 1894 ...	480–540	540	
Mr. W. H. Mackenzie ...	„ „	—	24th Jan., 1894 ...	480–540	540	
Mr. R. W. B. Darke	„ „	—	20th Feb., 1896 ...	540–600	540	
Mr. E. Sweney	„ „	—	22nd Sep., 1898...	480–540	540	
Mr. E. E. P. Clare	„ „	—	1st May, 1899 ...	480–540	480	
Mr. L. U. Stafford	„ „	—	1st Sep., 1900 ...	480–540	540	
Mr. R. A. Crawford	„ „	—	27th Jan., 1901 ...	480–540	540	
Mr. J. Bowes	„ „	—	15th Jan., 1902 ...	480–540	480	
Mr. E. W. Gever	„ „	—	4th Feb., 1902 ...	480–540	510	
Mr. G. M. Goodyear	„ „ (Acting Superintendent).	—	1st May, 1902 ...	480–540	540	
Mr. F. J. Gore	Assistant Superintendent	—	23rd Jan., 1904 ...	480–540	480	
Mr. C. J. Perkins	„ „	—	8th Feb., 1904 ...	480–540	480	
Mr. F. A. Sugden	„ „ (Office, Acting)	—	10th May, 1901 ...	360–420	420	
Mr. G. A. Hodges	Surveyor, 1st Grade	—	1st July, 1901 ...	360–480	480	
Mr. A. A. Campbell	„ „	—	15th June, 1902...	360–480	440	
Mr. A. Le Fevre	„ „ (Acting District Surveyor).	—	1st Aug., 1902 ...	360–480	360	
Mr. O. E. Jansz	Surveyor	—	1st July, 1903 ...	—	400	
Mr. R. Gillet	Office Assistant	—	17th Aug., 1903...	360–420	390	
Mr. E. C. Dew	Surveyor, 1st Grade	—	7th Mar., 1904 ...	360–480	400	
Mr. R. L. Buckwell	„ „	—	30th Apr., 1904...	360–480	400	
Mr. D. S. Richards	„ „	—	27th May, 1904 ...	360–480	400	
Mr. H. J. Mackenzie	„ „	—	25th June, 1904...	360–480	400	
Mr. W. H. Hanson	Office Assistant	—	11th Nov., 1904...	360–420	390	
Mr. F. S. Phillips	Surveyor, 1st Grade	—	3rd Aug., 1905 ...	360–480	400	
Mr. F. A. Wedde	—	Surveyor (on agreement)	30th June, 1906...	—	420	

Names.	Appointment.		Date of first appointment.	Salary of present appointment.	Actual salary.
	Pensionable.	Non-pensionable.			
	Revenue Survey Branch—continued.			£	£
Mr. T. Dewar	—	Surveyor	11th July, 1906 ...	—	420
Mr. F. B. Sewell	—	"	3rd Oct., 1906 ...	—	420
Mr. J. H. Johnston	—	"	18th Oct., 1906 ...	—	420
Mr. B. Cooper	—	"	25th May, 1907 ...	—	420
Mr. W. A. Gummer	—	"	1st Nov., 1907 ...	—	420
Mr. O. Krook	—	"	3rd Jan., 1908 ...	—	420
Mr. A. P. Schreiber	—	"	3rd Jan., 1908 ...	—	420
Mr. R. V. Morris	—	"	22nd Feb., 1908...	—	420
Mr. W. N. Horne	—	"	4th Mar., 1908 ...	—	420
Mr. J. W. P. Logan	—	"	4th Mar., 1908 ...	—	420
Mr. E. A. Barbour	—	"	5th Mar., 1908 ...	—	420
Mr. A. P. Chesney	—	"	8th Mar., 1908 ...	—	420
Mr. W. R. C. Piers	—	"	12th Mar., 1908...	—	420
Mr. J. Griffiths	—	"	4th April, 1908 ...	—	420
Mr S. Bunting	—	"	26th June, 1908...	—	420
Mr. C. Y. B. Sewell	—	" (on probation)	7th Oct., 1908 ...	—	360

CEYLON.

Name	Appointment.	Salary.	Date of Appointment.
Mr. P. D. Warren, C.M.G.	Surveyor-General	£ Rs. 12,750- Rs. 15,937.50.	23rd June, 1904.
Mr. R. S. Templeton ..	Assistant Surveyor-General ..	Rs. 9,000- Rs. 11,250.	23rd June, 1904.
Mr. H. O. Barnard.. ..	Trigonometrical, &c., Superintendent.		
Mr. W. C. S. Ingles ..	Superintendent of Applications, &c.	500-600.	
Mr. A. J. Wickwar ..	Superintendent, Topographical Surveys.		
Mr. J. W. Viner	Superintendent of Surveys ..		
Mr. A. E. Maddock ..	Ditto ditto ..		
Mr. J. B. M. Ridout ..	Superintendent of Surveys ..	Rs. 7,187.50.	
Mr. L. Shipton	Superintendents of Surveys ..	400-460.	4th May, 1907.
Mr. C. Meaden			1st Oct., 1907.
Mr. A. H. G. Dawson ..			1st Jan., 1908.
Mr. H. Erskine			?
Mr. C. F. W. Halliley ..			
Mr. C. R. Lundie			
Mr. J. W. Robertson ..			
Mr. G. F. Hepponstall ..			
Mr. A. J. Stronach.. ..			
Mr. A. E. Direkze			
Mr. D. Bloxham			5th Oct., 1907.
Mr. G. K. Thornhill ..			
Mr. C. H. Vince	Assistant Superintendents of Surveys.	300-350	13th June, 1908.
Mr. H. M. C. Ledger ..			13th June, 1908.
Mr. F. J. Salmon			13th June, 1908.
Mr. E. B. Manson			13th June, 1908.
Mr. J. A. Loram			30th July, 1908.
Mr. W. Ruddock			5th Nov., 1908.
Mr. N. B. Favell			6th May, 1909.
Mr. P. J. May			6th May, 1909.
Mr. F. L. Baker			6th May, 1909.
Mr. K. W. S. Mitchell ..			6th May, 1909.
Mr. H. P. Harrison ..			20th May, 1909.
Corpl. H. W. Johnson ..	Assistant Superintendents of Surveys.	250	22nd May, 1908.
Corpl. P. B. Lynch ..			22nd May, 1908.
Lce.-Corpl. E. E. O'Leary			22nd May, 1908.
Sapper F. E. Dainty ..			5th June, 1908.
Sapper G. A. Robertson..			5th June, 1908
Sapper J. Reid			5th June, 1908 (since died).

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584	Imperial Institute	1906–1907
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595	Basutoland	"
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597	St. Helena	1908
598	Gibraltar	"
599	Falkland Islands	"
600	Uganda Protectorate	1907–1908
601	Imperial Institute	1908
602	Northern Territories of the Gold Coast	"
603	Ashanti	"
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605	Weihaiwei	1908
606	Seychelles	"
607	Jamaica	1907–1908

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52	South Africa	Native Education.
53	East Africa Protectorate	Veterinary Bacteriological Work, 1907–08.
54	Newfoundland	Governor's Visit to the Micmac Indians.
55	Cape Colony	Rietfontein Area.
56	Turks Islands	Salt Industry.
57	Uganda	Governor's Tour.
58	British Colonies	Fibres.
59	Northern Nigeria	Mineral Survey, 1906–7.

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COLONIAL REPORTS—ANNUAL.

No. 644.

THE SURVEYS

OF

BRITISH AFRICA, CEYLON, CYPRUS, FIJI, JAMAICA, TRINIDAD, BRITISH HONDURAS.

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

FIFTH YEAR.

To 31st March, 1910.

(For Report for 1908–9, *see* No. 608.)

Presented to both Houses of Parliament by Command of His Majesty.
August, 1910.

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No. 644.

COLONIAL SURVEY COMMITTEE REPORT.

FOR THE YEAR ENDING 31ST MARCH, 191

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

S. C. N. GRANT, *Colonel, D.G. O.S.*
H. J. READ.
C. F. CLOSE, *Lt.-Col., Gen. Staff.*

W. C. BOTTOMLEY,
L. N. KING,
Captain, G.S.
} *Secretaries.*

July, 1910.

(16763—2.) Wt. 27349—322. 1125 & 85. 8/10. D & S. A 2

I.

REVIEW OF WORK IN AFRICA DURING THE PAST YEAR.

Topographical Surveys.—During the past year a total of about 43,500 square miles has been topographically surveyed in British Africa. The most important areas are :—

South Africa—		
Cape Colony	15,292	sq. miles.
Orange River Colony	11,574	„ „
Transvaal	600	„ „
East Africa	4,119	„ „
Uganda	8,935	„ „
Northern Nigeria	1,250	„ „

General Maps :—

Northern Nigeria.—A general map on a scale $\frac{1}{2000000}$ has been published.

Southern Nigeria.—A general map on a scale $\frac{1}{2000000}$ is in the proof stage, and will shortly be published.

Rough Surveys and Explorations have been carried out in the Anglo-Egyptian Sudan, the Gold Coast and Southern Nigeria.

Geodesy.—The work of measuring an arc of meridian in Uganda was completed by the joint Anglo-Congolese party in February, 1909. This arc is about 165 miles long and extends from 1° 10′ N. to 1° 10′ S.

The computations are about two-thirds completed.

Cadastral Surveys have been in progress in the Gold Coast, Southern Nigeria, East Africa and Uganda.

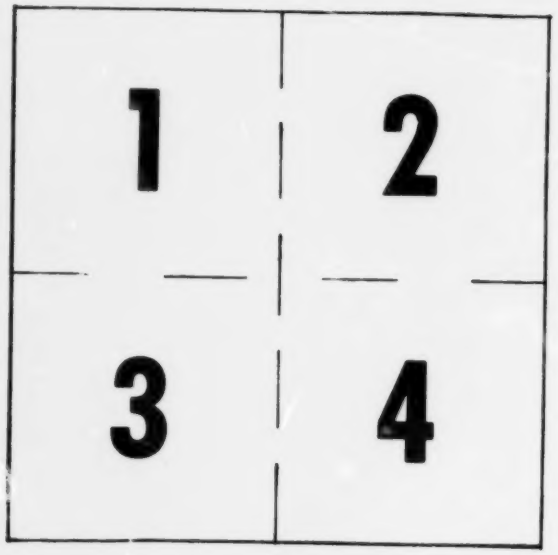
Boundary Commissions :—

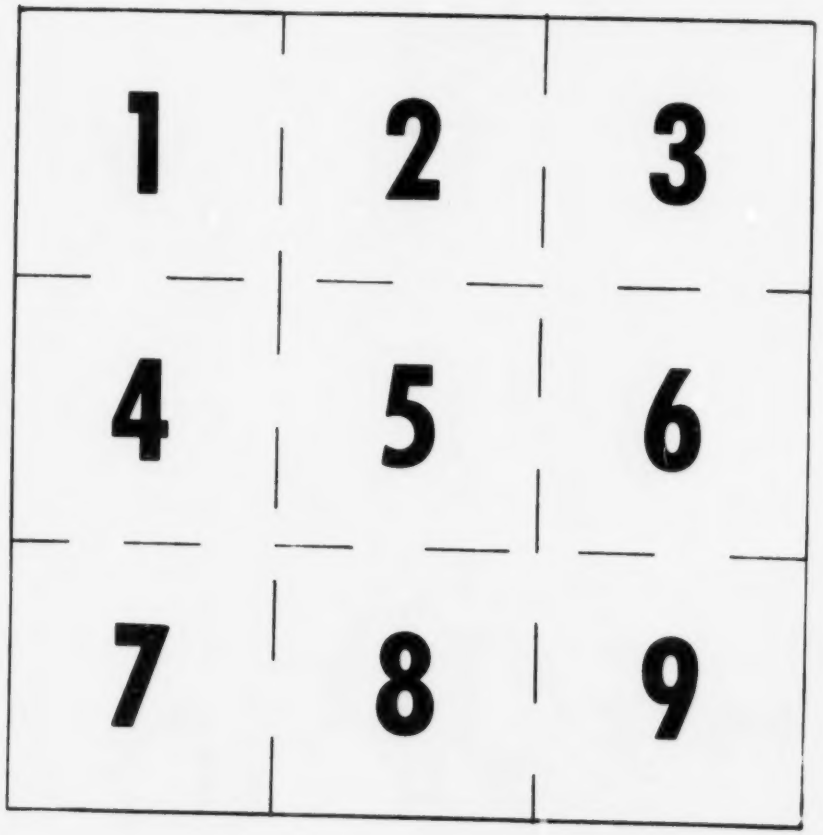
(i.) A detailed description of the Anglo-French Niger-Chad Boundary, between Northern Nigeria and French West Africa, was agreed upon at a conference held in London in February, 1910.

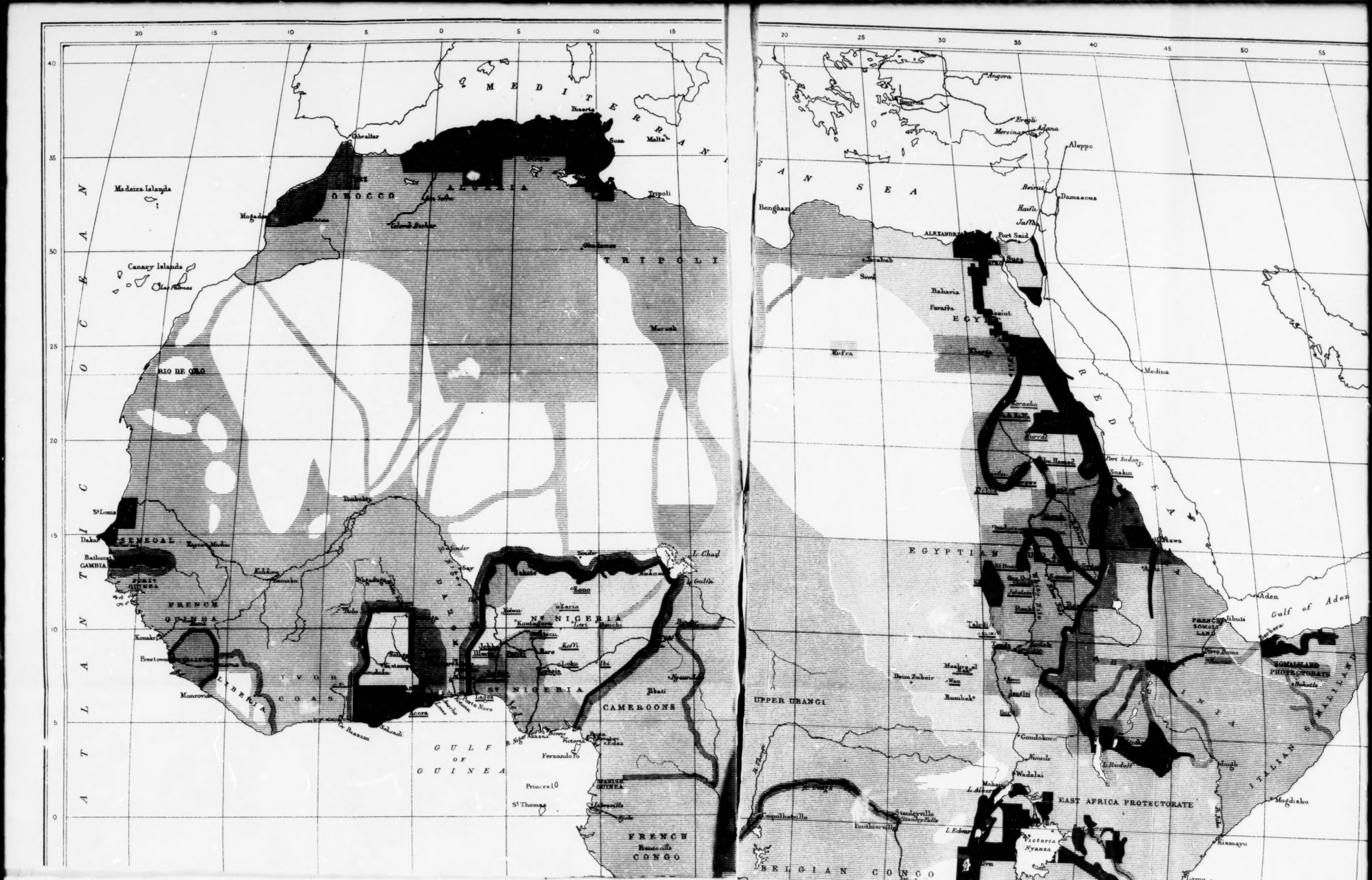
(ii.) A definite boundary between Nigeria and the Kameruns extending from Yola to the Cross River was recommended at a conference held in London in October, 1909.

(iii.) A conference sat at Brussels from February to May, 1910, to decide on the eastern frontiers of the Congo, and the Anglo-German frontier between Uganda and German East Africa, west of Lake Victoria. The results of the agreement have not yet been published.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.



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MEDITERRANEAN SEA
RED SEA
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Las Palmas
MOROCCO
ALGERIA
Bizerta
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Malta
Tripoli
TRIPOLI
Mogador
Mequinez
Fez
Tafilet
Colomb Bechar
Ghadames
Murzuk
RIO DE ORO
St Louis
Dakar
SENEGAL
Bathurst
GAMBIA
PORT. GUINEA
FRENCH GUINEA
Timbuctoo
Bandiagara
Sokoto
Kano
Zaria
Bauchi
NIGERIA
Lake Chad
Bornu
Kuka
Gulfei
Kousseri
Yola
Ibi
Nyanza
Ibadan
Abeokuta
Lagos
Porto Novo
Accra
Cape Coast
Salonadi
Monrovia
LIBERIA
IVORY COAST
GOLD COAST
Freetown
Konakry
Bissao
Bamako
Kolikoro
Segu
Sansanding
Jenne
Say
Sinder
Zinder
Kabbi
Illesha
Kaffi
Loko
Ilorin
Abutshi
Rabah
Benin
Bonny
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Calabar
Fernando Po
Princes I.
St Thomas
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SPANISH GUINEA
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Libreville
Gabon
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Rio del Rey
Akassa
Old Calabar
Adamawa
Kuka
Angora
Broussa
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Hawa
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Talodi
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Kassala
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Bohotle
ITALIAN SOMALILAND
Berber
Berti
Berber
Metemma
Gallabat
Fazogl
Beni Zubeir
Wau
Rumbek
Mashra el Rek
UPPER UBANGI
Gondokoro
Nimule
L. Rudolf
Wadelai
Mahagi
L. Albert
EAST AFRICA PROTECTORATE
Mogdishu
Kismayu
Victoria Nyanza
L. Edward
Stanleyville
Stanley Falls
Coquilhatville
Lusthierville
BELGIAN CONGO

M E D I T E R R A N E A N

Bizerta
Gibraltar
Suss
Malta
MOROCCO
ALGERIA
Tripoli
TRIPOLI
Marzuk
Rabat
Tangier
Fez
Mequinez
Tetuan
Oran
Algiers
Tunis
Gabes
Kano
Zaria
Kontagora
NIGERIA
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Illorin
Nupe
Kaffi
Loko
Ibi
Abeokuta
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GOLD COAST
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Farshut
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Suez
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Rosetta
Damietta
Benisuef
Faioum
Sinai
Jaffa
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Beirut
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Aleppo
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Adana
Mersina
Tarsus
Angora
Smyrna
Ephesus
Rhodes
Crete
Benghazi
Derna
Tobruk
Sollum
Siwah
Baharia
Farafra
EGYPT
Kufra
Medina
Mecca
Yambo
Jeddah
Loheia
Hodeida
Mocha
Aden
Gulf of Aden
RED SEA
EGYPTIAN SOUDAN
Talodi
Kordofan
Darfur
Beni Zuhair
Masheragel
Wau
Rumbek
Jonglei
Bor
UPPER URANGI
Gondokoro
Nimule
Wadelai
Mahagi
L. Albert
L. Rudolf
L. Edward
L. Victoria Nyanza
EAST AFRICA PROTECTORATE
Mogdishu
Coquilhatville
Stanleyville
Stanley Falls
Pentheirville
BELGIAN CONGO
INDIAN OCEAN

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BELGIAN CONGO

ANGOLA

GERMAN SOUTH WEST

BECHUANALAND PROTECTORATE

NORTH WESTERN RHODESIA

SOUTHERN RHODESIA

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MAP OF FRICA

ustrate the progress of surveys and explorations

REFERENCE

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scale of 250,000

British & Protected Territory

Foreign Territory

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GULF OF GUINEA

IVORY COAST

GOLD COAST

NIGERIA

CAMEROONS

FRENCH GUINEA

FRENCH CONGO

Princes I.

St Thomas

Fernando Po

Bonny

Victoria

Lagos

Porto Novo

Accra

Cape Palmas

Grand Bassam

St Louis

Timbuctoo

Sokoto

Kano

Yola

Bida

Ibi

Lokoja

Jebba

Nyassa

L. Chad

Bahr el Ghazal

Darfur

Kordofan

Khartoum

Port Sudan

Suakin

Berber

Abyssinia

Aden

Gulf of Aden

Djibuti

FRENCH SOMALI COAST

ITALIAN SOMALILAND

PROTECTORATE

Obbia

Mogdishu

Brava

Kismayu

Lamu

INDIAN OCEAN

MOMBASA

Zanzibar

Dares Salaam

Lindi

Mozambique

Comoro Is.

MADAGASCAR

EGYPTIAN SOUDAN

Dem Zubeir

Talodi

Mesheria el Arab

Bahr el Ghazal

UPPER UBANGI

Gondokoro

Wadelai

Nimule

L. Rudolf

L. Albert

EAST AFRICA PROTECTORATE

Victoria Nyanza

Kisumu

Mumias

Eldoret

Kavirondo

Nandi

Kikuyu

Ukamba

Kibwezi

Taveta

GERMAN EAST AFRICA

Kilimanjaro

Moshi

Pangani

Usambara

Mpwapwa

Tabora

Kilwa

Lake Tanganyika

Lake Nyassa

Livingstone

Blantyre

Zomba

Port Herald

Tete

Quelimane

Chinde

Beira

Sofala

Inhambane

Lourenco Marques

Delagoa Bay

PORTUGUESE EAST AFRICA

BELGIAN CONGO

Equateurville

Stanleyville

Stanley Falls

Lake Leopold II

Leopoldville

Brazzaville

Loanda

Benguela

Lobito B.

Mossamedes

Walfisch B.

GERMAN SOUTH WEST

BECHUANALAND PROTECTORATE

SOUTHERN RHODESIA

NORTH WESTERN RHODESIA

NORTH EASTERN RHODESIA

Lialui

Broken Hill

Bulawayo

Francis Fort

Victoria Falls

Nyamkwe

Kasenge

Lake Tanganyika

Lake Nyassa

R. Congo

R. Kasai

R. Niger

R. Benue

R. Zambesi

R. Shire

R. Limpopo

R. Juba

R. Webi Shebeli

R. Tana

R. Sabaki

R. Rovuma

R. Orange

Gt. Namaqua Desert

Kalahari Desert

Sahara

Libya

Tripoli

Ghadames

Murzuk

Bilma

Kuka

Kano

Sokoto

Timbuctoo

Bamako

Segu

Sansanding

Medina

Kayes

Senegal

Gambia

Bathurst

Sierra Leone

Liberia

Monrovia

Cape Palmas

Grand Bassam

Assinie

Axim

Cape Coast Castle

Accra

Addah

Porto Novo

Lagos

Benin

Bonny

Victoria

Fernando Po

Princes I.

St Thomas

Gaboon

Cape Lopez

Kabinda

Ambriz

Cape Frio

Walfisch B.

Angra Pequena

Cape Town

Port Elizabeth

East London

Durban

Delagoa Bay

Inhambane

Beira

Chinde

Quelimane

Mozambique

Comoro Is.

Madagascar

Zanzibar

Dares Salaam

Mombasa

Kismayu

Mogdishu

Aden

Gulf of Aden

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East London

Durban

Cape Frio

Ambriz

Kabinda

Cape Lopez

Gaboon

Assinie

Axim

Cape Coast Castle

Addah

Porto Novo

Lagos

Benin

Bonny

Victoria

Fernando Po

Princes I.

St Thomas

Bathurst

Gambia

Senegal

Kayes

Medina

Sansanding

Segu

Bamako

Timbuctoo

Sokoto

Kano

Bida

Yola

Ibi

Lokoja

Jebba

Nyassa

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Zanzibar

Dares Salaam

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Mozambique

Comoro Is.

Madagascar

Dem Zubeir

Talodi

Mesheria el Arab

Bahr el Ghazal

OF

AFRICA

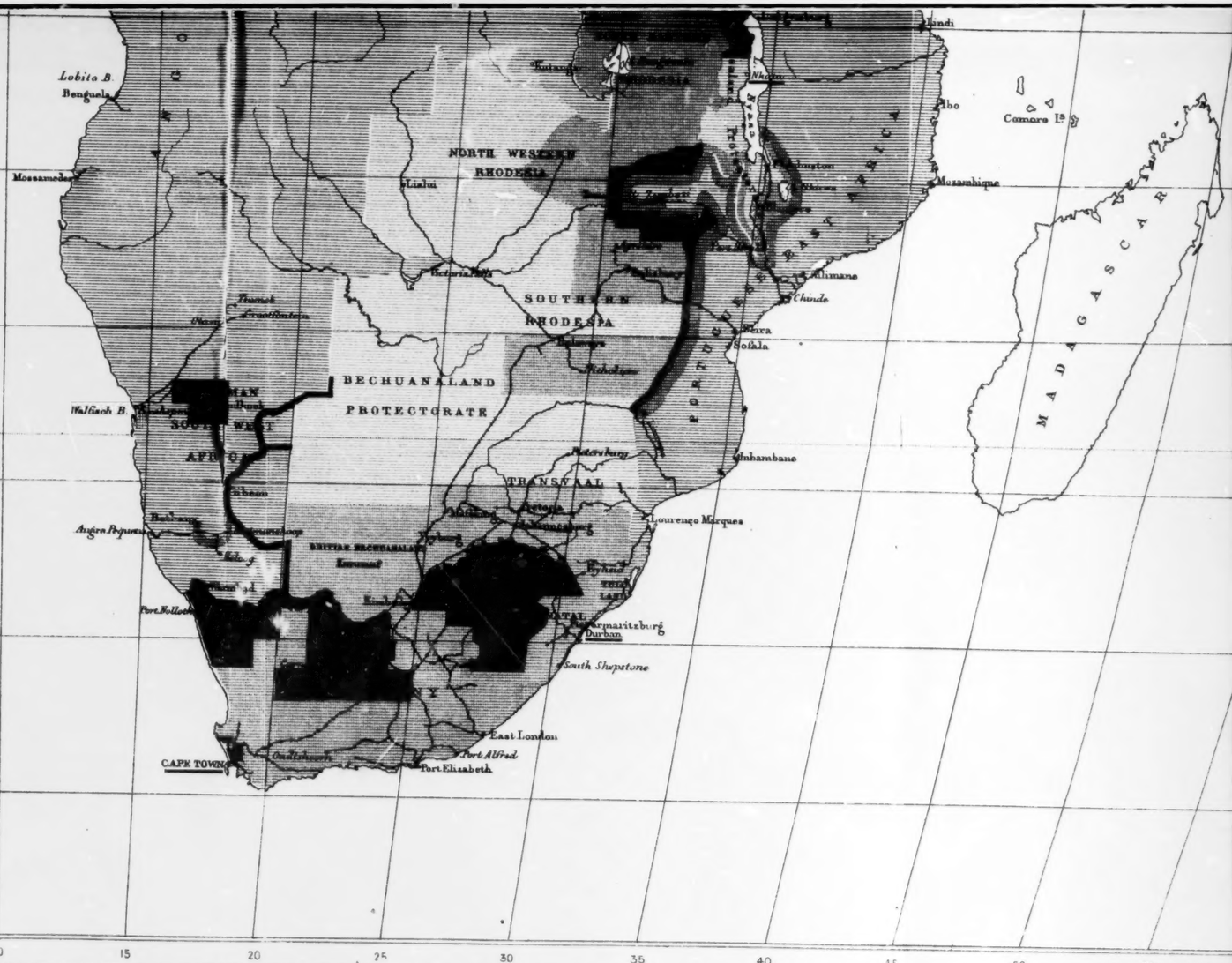
to illustrate the progress of surveys and explorations

REFERENCE

	British & Egyptian Territory	Foreign Territory
Surveys which may be taken as exact for reproduction on the scale of 250,000		
Surveys and explorations of an intermediate class		
Rough explorations		

NOTE — The whole of the coast line has been charted by the Admiralty.

The longitudes of places underlined in black have been determined by telegraphic comparisons.



Geographical Section, General Staff. N°2436

Scale 1/2,000,000 or 1 Inch to 315·65 Miles

MILES 100 0 200 400 600 800 1000 1200 1400 MILES

Scale 1 Centimetre to 200 Kilometres

KILOMETRES 100 0 100 300 500 700 900 1100 1300 1500 1700 KILOMETRES

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REFERENCE

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Drawn and printed at the War Office, Feb. 1909.
Photo-Etched at the Ordnance Survey Office, Southampton, 1909.
Corrected to March, 1910.

II.

REGULATIONS AFFECTING SURVEY DEPARTMENTS.

(i.) The Spelling of African Place Names.

The Secretary of State has approved of the following rules for the spelling of place names in British Tropical Africa :—

(*a*) Established forms of spelling of well known places are to be retained, *e.g.*, Coomassie, Accra.

(*b*) The spelling of other place names is to be in accordance with the rules of the Royal Geographical Society. (Briefly, in this system, the consonants are as in English and the vowels as in Italian.)

(*c*) The Director of Surveys in each Colony or Protectorate (or, where there is no Director of Surveys, the Intelligence Officer), is responsible for the correctness of the spelling of the place names on field sheets sent home for reproduction. He will ascertain the true spelling from Commissioners and Residents.

In any case in which it is doubtful whether a name should be dealt with under (*a*) or (*b*) the question should be referred to the Governor for decision.

(ii.) Appointments to Survey Departments.

The Secretary of State for the Colonies has approved of the following arrangements for the selection of candidates for junior survey appointments in Crown Colonies and Protectorates.

1. For the purpose of selecting surveyors, Ceylon, the Federated Malay States, and the East Africa and Uganda Protectorates will be grouped, and candidates will be required to pass the same tests and go through the same preliminary training. Candidates will, however, be allowed to indicate their preference for particular Colonies, and, if they wish it, to await the occurrence of vacancies. It is possible that other Colonies or Protectorates may be included in these arrangements in the future, but for the present they will apply only to the countries named, which are those in which vacancies may be expected to occur most frequently.

2. Candidates must be between the ages of 21 and 27 and should be unmarried, as the conditions of service for surveyors in the countries concerned are not suitable for a married man.

3. Anyone wishing to become a candidate for these posts should apply in writing to the Private Secretary to the Secretary of State, Colonial Office, London, S.W. He will be required to fill in a form of application and to furnish testimonials and the name of two referees. If the information thus obtained is considered satisfactory, he will be asked to call at the Colonial Office for a personal interview, and, if accepted, will be nominated as a candidate.

4. A candidate not exempted under paragraphs 5 or 6 of this Memorandum will be required to pass two tests:—

(*a.*) A qualifying examination in mathematics, including algebra, geometry, and plane and spherical trigonometry, and

(*b.*) A qualifying examination in the use and adjustment of surveying instruments. This examination will include the theodolite, level, compass, chain, tape, plane table, clinometer, and barometer. It is not, however, necessary that the candidate should have had other than academical experience of the use of these instruments.

For these examinations, which will be conducted at the Surveyors' Institution, an examiner nominated by the Secretary of State will be associated with the examiners nominated by the Institution. The candidate will be required to pay a fee of one guinea for each examination.

5. A candidate who has passed with honours in mathematics, physical science, or engineering, or who has obtained an equivalent diploma or distinction, in a University or school of a University in the United Kingdom, or who has been licensed to practice as a Surveyor in one of His Majesty's Dominions, will not be required to undergo any technical or educational test.

6. A candidate who has passed the examination for the Associated Membership of the Institute of Civil Engineers or for the Professional Associateship or Fellowship of the Surveyors' Institution, or who has obtained the surveying diploma of the Royal Geographical Society, will be exempt from the technical test referred to in paragraph 4 (*b*) above.

7. Candidates who have passed the qualifying tests or have been exempted will then be required to undergo a medical examination by one of the medical advisers to the Colonial Office in London, Edinburgh, or Dublin. A fee of one guinea will be charged for this examination.

8. According to the number of vacancies, candidates will then be sent to the Ordnance Survey Office, Southampton, for a course of instruction not exceeding two months. If reported on favourably by the Director-General of the Ordnance Survey, but not otherwise, a candidate will become a Survey Probationer and will be granted the amount of his actual travelling expenses* incurred in connection with the course, and a lodging allowance of 2*s.* 6*d.* a day and a subsistence allowance of 5*s.* a day for each day spent at Southampton.

9. A Survey Probationer will be sent out to the Colony or Protectorate to which he is posted at a salary of £250 a year, with free quarters or an allowance in lieu thereof when stationed at headquarters. He will draw half pay on the voyage out and will not begin to draw full pay until his arrival in the Colony or Protectorate.

10. At the end of one year he will, if approved by the Surveyor-General or Director of Surveys, be appointed to the Department at the ordinary rate of pay attached to junior survey appointments.

* Travelling expenses are not granted in respect of the candidates' call at the Colonial Office or his qualifying or medical examinations

These rates of pay in the various Colonies or Protectorates are as stated in the following paragraph. The appointment will be for three or five years in the first instance, with a prospect of re-engagement if the Surveyor's service continues to be satisfactory and of ultimate appointment to the permanent establishment in the case of Ceylon and the Federated Malay States. In East Africa and Uganda only a few of the highest appointments in the Survey Department are permanent and pensionable.

11. The rates of salary payable after the expiration of the period of probation are as follows:—

Ceylon.—Assistant Superintendent of Surveys	£300 to £350 a year by annual increments of £10.
Federated Malay States.—Second-Grade Surveyor	£300 to £360 a year by annual increments of £15.
East Africa and Uganda.—Junior Staff Surveyor	£250 to £280 a year by annual increments of £15.

12. If at the end of a year's probation a Probationer is not approved, his appointment will be terminated, and he will have no claim to any compensation beyond a free passage back to England. The probationary period of one year may, however, be extended at the discretion of the Governor or High Commissioner if the extension is recommended by the Surveyor-General or Director of Surveys on account of special circumstances.

13. The Secretary of State does not by these arrangements preclude himself from considering an application for appointment from a Surveyor who is fully qualified in the practice of his profession but who is unable by reason of age to offer himself as a candidate for a Survey Probationership.

Colonial Office,
July, 1910.

(iii.) Adoption of the International System of numbering Maps.

In future all maps of Crown Colonies or Protectorates of which the edges are meridians and parallels, which are $\frac{1}{4}°$ square, $\frac{1}{2}°$ square, or 1° square, will be numbered according to the system approved by the International Map Committee in their Resolutions dated 20th November, 1909. In this system each sheet on the scale of $\frac{1}{1000000}$ covers an area of 6° in longitude by 4° in latitude, the east and west edges being at every 6° reckoning from the anti-meridian of Greenwich, and the north and south edges at every 4° reckoning from the equator. Each sheet is described "North" or "South" according as it is in the Northern or Southern hemisphere, and is further defined by the letter of the latitude zone and the number of the longitudinal sector. The incidence of the sheets is shewn on the diagrams facing page 28. Thus the sheet which

covers the southern portion of Ceylon is *North B. 44.* One of the sheets of South Africa is *South H. 34.*

Each of the sheets on the scale of $\frac{1}{1000000}$ includes 24 sheets on the scale of $\frac{1}{250000}$. These latter sheets are lettered thus :—

A	B	C	D	E	F
G	H	I	J	K	L
M	N	O	P	Q	R
S	T	U	V	W	X

The description of one of the $\frac{1}{250000}$ sheets of South Africa, would thus be :—

South H. 34
D

Each sheet on the scale of $\frac{1}{250000}$ covers the area embraced by four sheets on the scale of $\frac{1}{125000}$. These latter sheets are numbered thus :—

I	II
III	IV

The description of one of the $\frac{1}{125000}$ sheets of South Africa, would thus be :—

South H. 34
D. III

As another example, the sheet on the scale of $\frac{1}{125000}$ which is $\frac{1}{2}^{\circ}$ square, and covers the country round Nairobi, in British East Africa, is thus described :—

South A. 37
G. II

Each sheet on the scale of $\frac{1}{125000}$ covers the area embraced by four sheets on the scale of $\frac{1}{62500}$. These latter sheets are lettered thus :—

N.W.	N.E.
S.W.	S.E.

One of the sheets of South Africa on the scale of $\frac{1}{62500}$ would thus be described :—

South H. 34
D. III. S.E.

III.

REPORTS ON THE SURVEYS OF BRITISH AFRICA.

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CAPE COLONY	18
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THE ANGLO-EGYPTIAN SUDAN.

Governor-General ...	Lt.-General Sir F. R. WINGATE, K.C.B., K.C.M.G., D.S.O.
Director of Surveys ...	Captain H. D. PEARSON, R.E.
Assistant-Director of Surveys	Captain A. E. CONINGHAM, R.E.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but it has been thought desirable to include an account of these surveys in order to make the review of the mapping of British Africa more complete.

The $\frac{1}{250000}$ *Series.*—This series, consisting of 120 sheets covering the whole of the Sudan, has been completed in a provisional form. These sheets are being continually revised and when an adequate amount of new work has been obtained for any sheet a revised edition is published. Thirty-six of these sheets have been published in a revised form during the last two years.

Nine of these sheets have been published during the last year, six of which include some recent survey work in Western Abyssinia carried out by Captain Kelly, R.E., of the Sudan Roads Department.

The $\frac{1}{1000000}$ *Series.*—This series has also been completed in a provisional form for administrative purposes.

These sheets are being revised in accordance with the new positions of stations which are determined from time to time. New work is added and when sufficient material is available a new edition is published. No revised sheets have been published this year. Arrangements have been made with the Egyptian Survey Department to undertake the reproduction of these sheets when they are ready.

The longitudes of the undermentioned places have been fixed during the past year :—

Port Sudan.	Melut.
Korosko.	Kodok.
Dongola.	Mongalla.
Senga.	Lado.
Bara.	

Town Surveys.—The surveys of Rufaa and Atbara have been completed, and the survey of Omdurman is well advanced.

EAST AFRICA PROTECTORATE.

Governor	Colonel Sir E. P. C. GIROUARD, K.C.M.G., D.S.O.
Director of Surveys	Major G. E. SMITH, C.M.G., R.E.
Deputy Director of Surveys, Trigonometrical and Topographical Branch.	Captain G. S. KNOX, R.E.
Deputy Director of Surveys, Cadastral Branch.	Mr. A. E. TOWNSEND.
Assistant Directors of Surveys, Trigonometrical and Topographical Branch.	Captain G. C. WILILAMS, R.E., Lieutenant A. M. COODE, R.E.
Assistant Director of Surveys, Cadastral Branch.	Mr. T. H. GALBRAITH.

(i.) STAFF.

Superintending Staff.

Director of Surveys.	1 Clerk and Storekeeper. 1 Assistant Clerk.

Trigonometrical and Topographical Branch.

Deputy Director. 2 Assistant Directors.	4 Surveyors (N.C.Os., R.E.).

Cadastral Branch.

Deputy Director. Assistant Director. 12 Surveyors. 2 Clerks.	1 Draughtsman. 10 Indian Surveyors and Draughtsmen.

(ii.) The Work of the Past Year.

Triangulation.—The work done in 1909–10 was wholly on the coast, with a view to preparing maps for the settlement of Mahomedan claims to land.

The season was wetter than in the previous year so the difficulties about water were not so serious.

The nature of the country was, however, unfavourable for triangulation, as west of a strip about 12 miles wide along the coast the country consists of a gently rolling plain, so densely covered with thick bush that the average rate of marching was about one mile in two hours.

As a view of any sort was only to be obtained by climbing trees it became a matter of difficulty to fix suitable points for beacon building.

The staff available consisted of two officers for observing, computing and beaconing, and one N.C.O. for beaconing only.

The whole of the area east of 39° 30′ E. and between 3° and 4° S. was covered with major and minor points, and all these points were observed and computed between June and January.

In January, 1910, a check base (about $1\frac{1}{2}$ miles long) was measured near the mouth of the Sabaki with the Jäderin apparatus.

This gave a satisfactory check on the triangulation as carried over some 400 miles from a base near Athi River station.

Stellar observations for latitude and azimuths were also taken near the Sabaki base, and these agreed well with those deduced from the triangulation from Athi River.

Two other officers assisted for three weeks in the operations connected with the base measurement and the star work.

Both the officers of the Trigonometrical Branch were disabled from time to time with fever, the part of the Protectorate in which they were working being notoriously unhealthy. In January one officer had to be sent to the hills on account of ill-health.

In March he left to commence triangulating in Laikipiak, which lies roughly west of Mount Kenya.

The high standard of accuracy in the triangulation obtained in previous years was maintained.

Topography.—One officer and three non-commissioned officers were available for the greater portion of the year.

The sheets near Nairobi which had been covered by tertiary triangulation in the early months of 1909, were surveyed in the field on a scale of $\frac{1}{12500}$.

Some of the work on the forest-covered Aberdare Range was difficult. A sheet on a scale of $\frac{1}{62500}$ of the country round Nairobi was also completed in the field.

About October, 1909, the Topographical party was ordered to the coast, and by the end of March completed the field sheets covering an area to the east of 39° 30′ E. and lying between 3° and 4° S.

For about two months of this period the officer was employed on work connected with base measurement. All the N.C.Os. were also employed on this work for two weeks.

Much of the country was unsuitable for plane table work owing to the restricted view. Compass traversing was employed in these districts.

About 200 square miles were surveyed on the $\frac{1}{62500}$ scale for the settlement of land claims, and the remainder 2,000 square miles were surveyed on the $\frac{1}{125000}$ scale.

Owing to the numerous dialects in the country and to the fact that there is no written language much time is necessarily occupied in arriving at the best place names, the same feature often having several local names.

The health of the party, considering the arduous nature of the work in the midst of unhealthy surroundings was satisfactory.

On one occasion a camp was destroyed at night by a herd of elephants, but there was no loss of life.

The $\frac{1}{125000}$ sheet entitled Nairobi has been reproduced and published.

The $\frac{1}{62500}$ map of the country round Nairobi has also been published during the past year.

It is for consideration whether economy might not be effected by the reduction of the scale of the topographical map of the Protectorate.

Cadastral Branch.—The report of this branch has not been received.

Rapid Allotment.—The Committee note with great satisfaction that the arrears of work in connection with the settlement of land claims have been practically overtaken.

The triangulation of a fresh area in the Laikipiak district which is to be utilised to form a frame work for a rapid allotment survey was commenced in March, 1910.

Five sheets of the Rapid Allotment Survey of the Uasin Gishu Plateau on a scale of $\frac{1}{62500}$ were reproduced and published during the past year.

THE GOLD COAST.

Governor ... ... Sir JOHN RODGER, K.C.M.G.
Director of Surveys ... ... Captain E. F. W. LEES, R.E.

STAFF.

The Staff of the Survey Department consists of :—

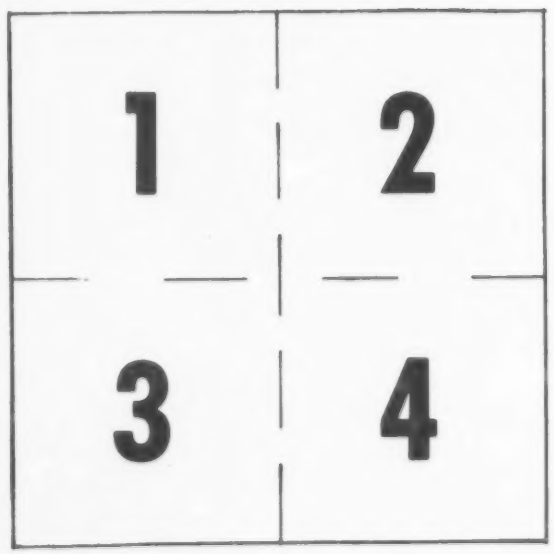
Director of Surveys.	3 Native Surveyors.
4 N.C.Os., Royal Engineers (Surveyors).	1 Native Draughtsman.
	1 Clerk.

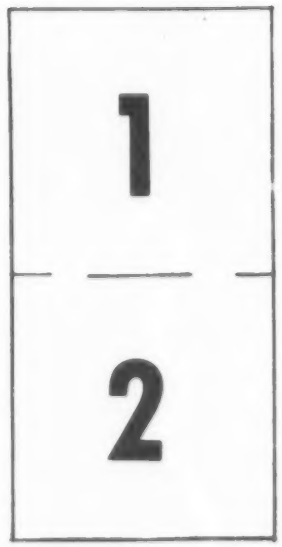
THE WORK OF THE PAST YEAR.

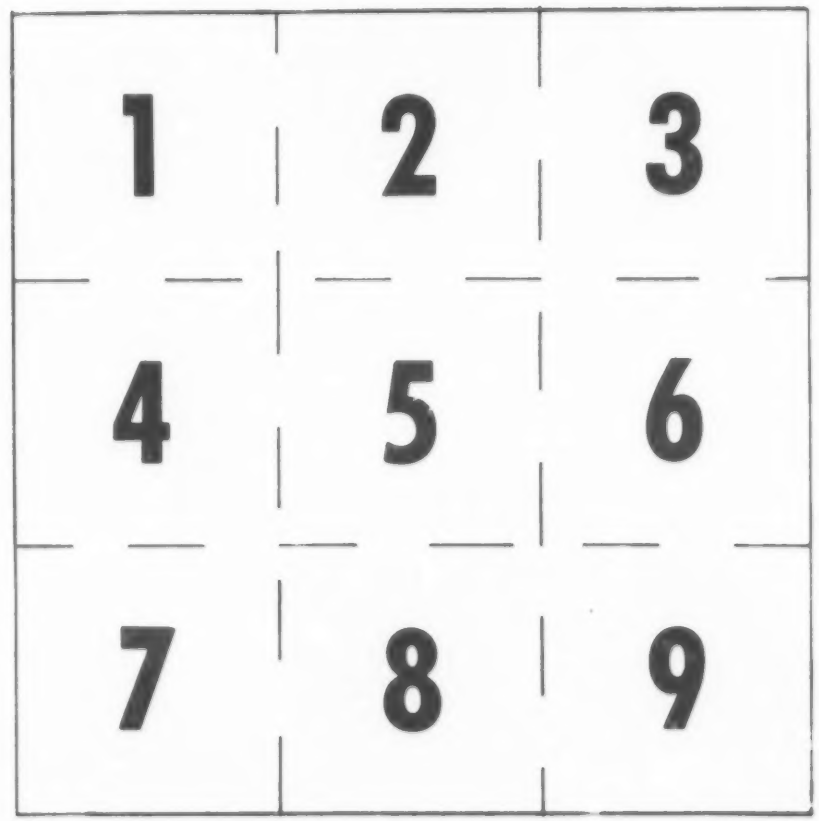
(*a*) *General.*—The year has been remarkable for the very large increase in the number of orders received for the demarcation of mining concessions, and the Department found itself quite unable to cope with the work. There were 51 concessions awaiting survey on the 31st March, 1910. Considerable temporary assistance was approved, and three* additional surveyors arrived in the Colony in

* Of which number one died five weeks after landing in the Colony.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.

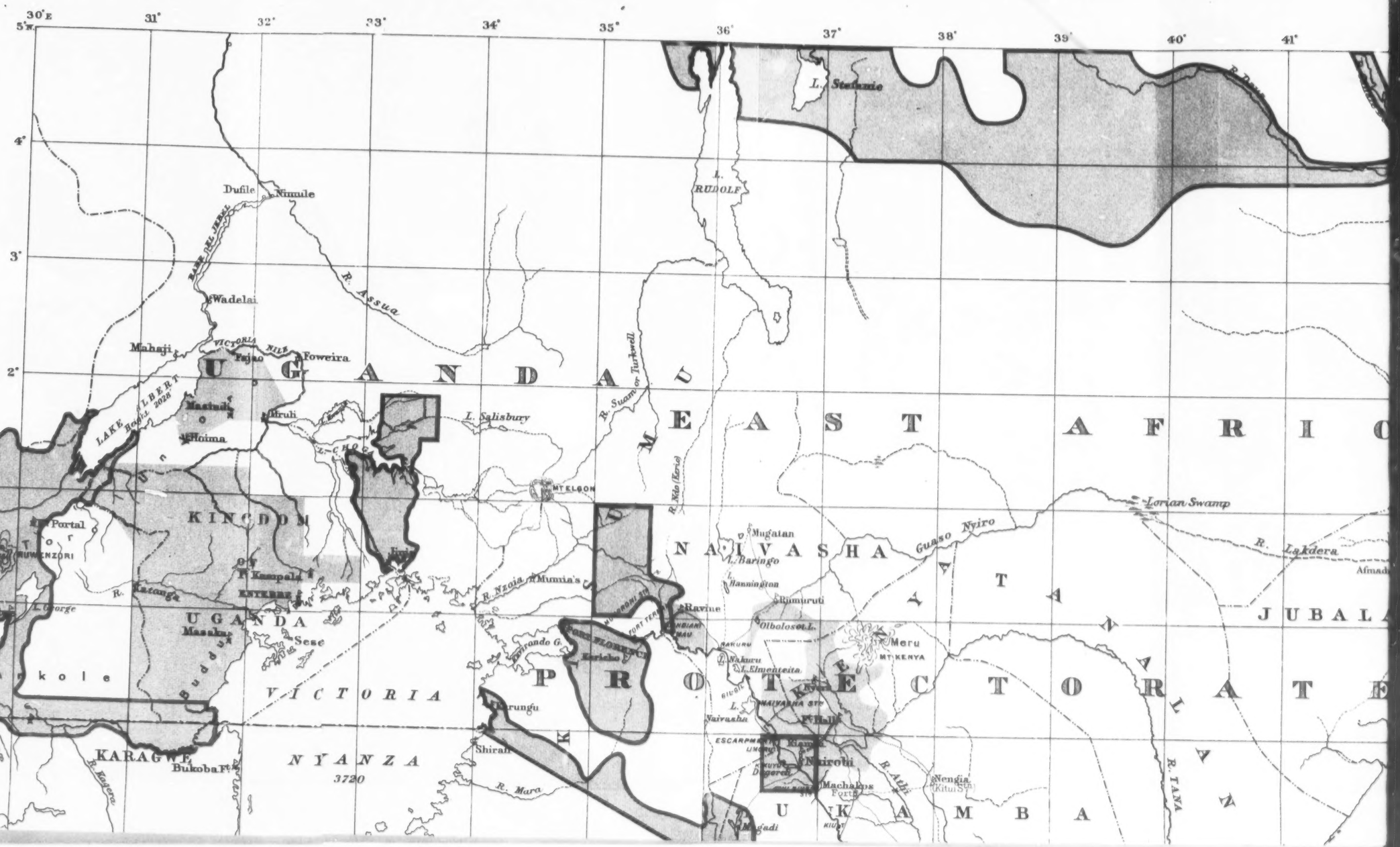






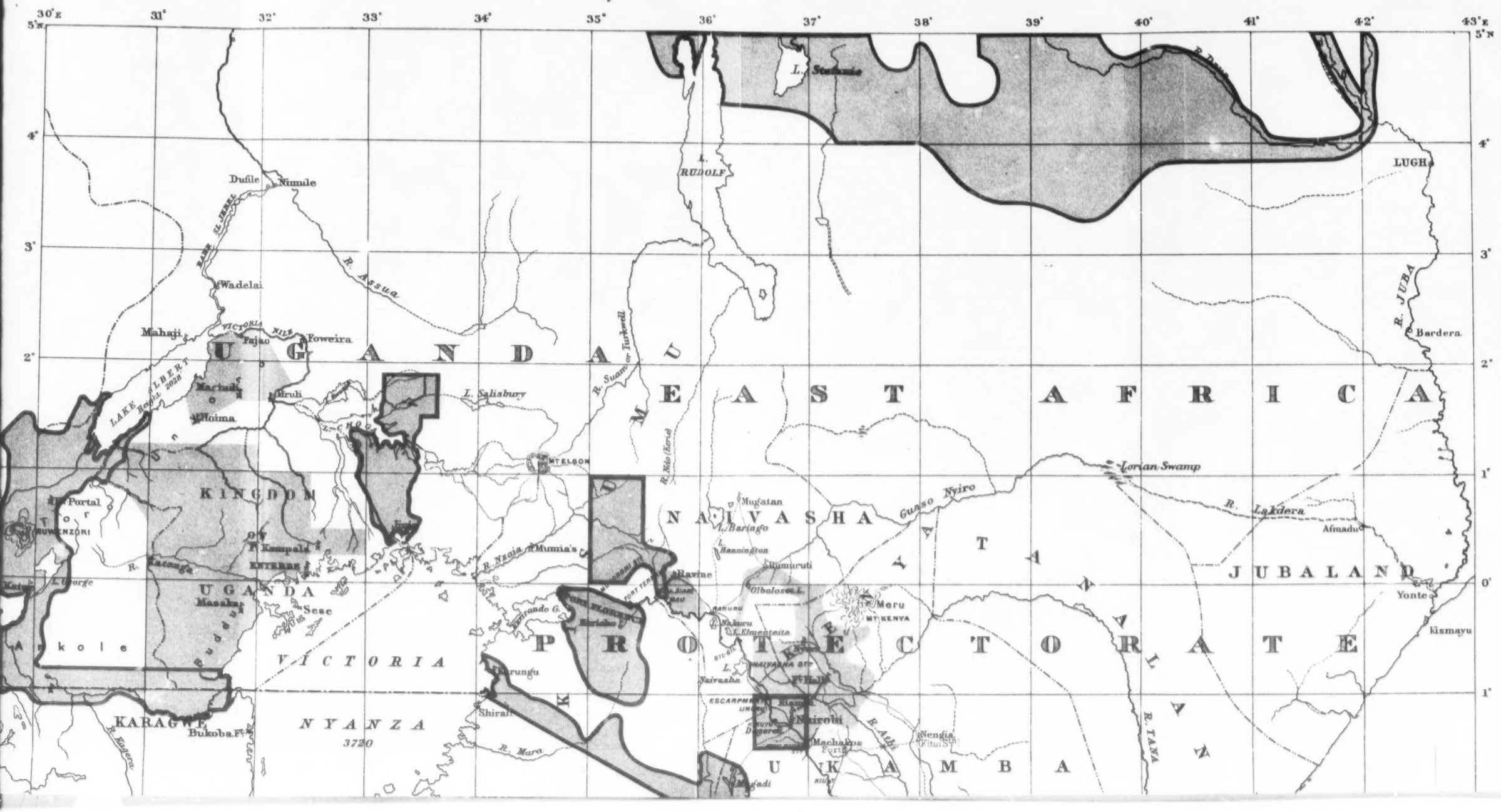
INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA



INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA



EAST AFRICAN PROTECTORATE

GERMAN EAST AFRICA

UGANDA

KINGDOM OF KITWARA

KARAGWE

NYANZA

NAIVASHA

MASAILAND

JUBALAND

SEYIDIE

UKAMBA

LAKE ALBERT 2026

LAKE EDWARD 3003

VICTORIA NYANZA 3720

MT ELGON

MT KENYA

MT KILIMANJARO 19,700

MT MERU

MFUMBIRO MT

L. KIVU

Lorian Swamp

R. Lakdera

R. Galana

R. Tana

R. Nzoia

R. Kagera

R. Mara

R. Athi

Tiva R.

Guaso Nyiro

Mumia's

Kavirondo G.

Port Victoria

Port Florence

Port Portal

Fort George

Fort Hall

Fort Smith

Fort Ternan

Fort Hannington

Fort Tulo

Fort Hall

Machakos Fort

Kibwezi

Voi

Voi-Taveta Road

Mazeras

Rabai

Fort Jesus

Kisumu

Sese

Bukoba

Muanza

Shirati

Kisii

Kericho

Nakuru

Naivasha

L. Elmenteita

L. Baringo

L. Hannington

L. Jipe

L. Natron

Olbolosat L.

Ravine

Mugatan

Ummuruti

Meru

Nairobi

Nzoia

Machakos

Nengia (Kitui Stn)

Ikutha (M.S.)

Olgos

Moshi

Taveta

Mwatate

Voi

Takaungu

Malindi

Witu

Lamu

MOMBASA

Wilhemstal

Vanga

Tanga

Pemba Id.

Pangani

Ujiji

Tabora

Escarpment Line

Kavirondo Gulf

Fort Ternan

Fort Tulo

Fort Hall

Fort Smith

Fort Hannington

Fort Portal

Fort George

Fort Victoria

Port Florence

Kisumu

Sese

Bukoba

Muanza

Shirati

Kisii

Kericho

Nakuru

Naivasha

Machakos

Nengia

Ikutha

Olgos

Moshi

Taveta

Mwatate

Voi

Takaungu

Malindi

Witu

Lamu

Wilhemstal

Vanga

Tanga

Pemba Id.

Pangani

Ujiji

Tabora

Mumia's

Ravine

Mugatan

Ummuruti

Olbolosat L.

Meru

Nairobi

Machakos

Nengia

Ikutha

Olgos

Moshi

Taveta

Mwatate

Voi

Takaungu

Malindi

Witu

Lamu

Wilhemstal

Vanga

Tanga

Pemba Id.

Pangani

Ujiji

Tabora

REFERENCE

Telegraph lines

Railways

Cart roads

Cleared (Trade) routes

Caravan tracks

Gov^t Stations

Topographical Section, General Staff; N° 2291.

Topography completed in the field

Topography published

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

30° E 31° 32° 33° 34° 35° 36° 37° 38° 41° 42°

2° 3° 4° 5° S

EAST AFRICA

REFERENCE

Telegraph lines
Railways
Cart roads
Cleared (Trade) routes
Caravan tracks
Gov^t Stations

Topographical Section, General Staff; N° 2291.

Topography completed in the field

Topography published

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

Revised, June 1910.

February, 1910, and it is hoped that the concession surveys will now be dealt with more expeditiously.

(*b*) *Trigonometrical work.*—None was executed.

(*c*) *Topographical work.*—An exploration was made of some 2,000 sq. miles of the country south of latitude 5° 30′ N. between the Ankobra and Tano rivers.

In addition, reconnaissance surveys for the Accra–Akwapim railway extension were completed.

(*d*) *Cadastral work.*—The cadastral work undertaken during the year may be considered under two headings :—

Town Surveys.
Concession Surveys.

Town Surveys.—This work is very arduous ; the great heat in the streets and lanes of the towns, and the very often insanitary surroundings, tell severely on both European and native surveyors, and the large collections of huts, built without reference to any definite alignment or design, and very often without more than one or two feet between their outside walls, make an accurate survey at a reasonable rate of progress a matter of considerable difficulty.

Accra.—Owing to the re-designing of the town, and to the pressure of work elsewhere, no attempt was made to complete the surveys of the suburbs of Victoriaborg and Christiansborg, and of all the land within the municipal area.

Sekondi.—The work in connection with the survey of this town was very intermittent, but fair progress was made. About half the town has been surveyed in detail, and a large part of four sheets has been drafted. Pressure of concession work necessitated the withdrawal of the Surveyor in charge.

The map of the town will be on a scale of $\frac{1}{1200}$, in 10 sheets, and it is hoped that the survey will be completed in June. A plan on a scale $\frac{1}{600}$, showing the business and European areas in detail, and the native town in blocks, has just been completed.

Coomassie.—Good progress has been made with the survey of this town. The field work is practically completed, and nine of the 14 sheets, on a scale of $\frac{1}{600}$, containing the Zongo, European and native areas, have been drafted in readiness for the final check in the field. It is hoped that this survey will be completed in the course of the current year.

Mangoase.—A scheme for the roads in this town has been drawn up, beacons have been fixed, and the European reserve has been defined.

Concession Surveys.—During April, May and June, practically no concession surveys could be undertaken, owing to the absence of European supervision. In September all the Surveyors, with one exception, were employed on concession surveys. The rate of defining the boundaries shows a satisfactory increase, and the standard of accuracy has been well maintained. The average closing error was a fraction under 1 in 4,000, the permissible closing error being 1 in 2,000.

Good progress has been made with the demarcation of the large oil concessions on the western frontier ; it is expected that these

concessions will be completed by the end of April. The fees for this particular service amounted to about £1,200.

The following concession, in hand on the 31st March, 1909, is now completed :—

Takwa-Prestea Railway Timber Concession.

The following concessions were undertaken and completed in the year ending 31st March, 1910 :—

Prestea-Huni River Railway Timber Concession.
Quaw Badoo Extension Concession.
Essikaman Extension Concession.
South Kawere Concession.
Cadbury's Mangoase Concession.
Obuosu Concession.
Allaganzuli Concession.
Dagwin Extension Concession.
Awunaben Ahoonabe Concession.
Essawarwin Concession.
Tamsoo (Takwa) Reef Remainders.

The following concessions were in hand on the 31st March, 1910 :—

Epon Concession.
Tachinta Concession.
Takwa-Prestea Railway Mining Concession, No. 1.
Takwa-Prestea Railway Mining Concession, No. 2.

The survey of the Avreboo Concession was commenced in January, but owing to the delays caused by disputes as to the ownership of the land, the survey party was removed.

The fees earned, including the value of the work done on the concession surveys in hand on the 31st March, amounted to £2,635. The area of the concessions surveyed was 86,546 acres.

(*e*) *Special work.*—The boundaries of the Dengiassi lands were beaconed, to prevent further disputes. In connection with the concession work near Takwa, the Takwa-Prestea Railway was rigidly traversed. In April the rigid traverse of the last 20 miles of the route for the new motor road to the Northern Territories was completed, and longitudinal sections drawn of the whole distance.

(*f*) *Map production.*—No new maps were produced during the year. It is proposed to produce during the current year, revised editions of various sheets of the colony map, and also a new map in four sheets, scale $\frac{1}{50000}$, of the mining districts round Takwa and Prestea.

(*g*) *Miscellaneous.*—Increased difficulty was experienced during the year in obtaining a satisfactory supply of labour for the survey parties, especially in the mining districts where higher pay can be obtained for lighter work.

Ashanti.

Little progress has been made with the map of Ashanti owing to the many and varied duties of the Intelligence Officer who is responsible for the compilation.

A scheme was submitted for the completion of the map in two years, but the necessary funds could not be made available.

Cost of the Department and Money allotted for the different Services.

Personal Emoluments.

	£	s.	d.	£	s.	d.
Director of Surveys	700	0	0			
" " Duty Allowance...	140	0	0			
Two Surveyors	524	16	8			
One Surveyor	166	13	4			
Three Temporary Surveyors	97	9	9			
One Native Surveyor	212	10	0			
Two Native Assistant Surveyors ...	206	2	3			
One Native Draughtsman	126	5	0			
One 4th Grade Clerk	66	0	5			
				2,239	17	5

Other Charges.

Stores	135	0	0		
Stationery and Office Stores	20	0	0		
Hire of Quarters	40	0	0		
Horse Allowances	72	0	0		
Bicycle Allowances	32	5	0		
Passages of Officers	47	10	0		
Passages coastwise	10	0	0		
Travelling Allowances	62	10	0		
Freight coastwise	1	5	0		
Carriers	1,000	0	0		
Contingent	5	0	0		
Special Expenditure	300	0	0		
				1,725	10	0
				3,965	7	5

NORTHERN NIGERIA.

Governor ... . Sir H. Hesketh Bell, K.C.M.G.
Intelligence Officer ... Captain H. N. Kempthorne, R.Sc.Fus.

During the past year about 1,250 square miles of topographical work on a scale of $\frac{1}{125000}$ has been surveyed in the field by Captain Kempthorne.

The compilation of the map of the Protectorate on a scale of $\frac{1}{250000}$ has been completed with the exception of five sheets. The reproduction of the 68 sheets of this map is now in hand, and one sheet has been published.

A general map of the Protectorate on a scale of $\frac{1}{2000000}$, together with an index of names, has been published.

In the opinion of the Colonial Survey Committee, Captain Kempthorne is doing excellent work in the compilation of these preliminary maps of the Protectorate.

SOUTHERN NIGERIA.

Governor	...	...	Sir WALTER EGERTON, K.C.M.G.
Director of Surveys	...	...	Mr. E. P. COTTON.
Intelligence Officer	...	...	Captain W. H. BEVERLEY.

STAFF.

The Staff of the Survey Department consists of :—

Director of Surveys.
Deputy Director of Surveys.
6 European Surveyors.
6 Native Surveyors.
1 European Draughtsman.
12 Native Clerks and Draughtsmen.

WORK OF THE PAST YEAR.

(*a*) *Trigonometrical work.*—Nil.

(*b*) *Topographical work.*—The country between 7° and 8° N. latitude and 3° and 5° E. longitude, comprised in sheets 73 D and E, was contoured approximately.

(*c*) *Cadastral work.*—The principal work undertaken was the detailed survey of Lagos Town, of which one-fourth of the area was completed. Large scale plans of town sections were drawn for real property investigations and were reduced to the scale of $\frac{1}{1056}$.

Surveys of properties on the Ikoyi Plains, several expropriations at Ebute Metta as well as scattered surveys in the town for acquisition, street alignment, &c., were effected.

The towns of Benin and Burutu were surveyed.

Surveys were made in connection with schemes for the Lagos water supply and disposal of sewage.

The valley of the River Ogba was surveyed for the Benin water supply.

(*d*) *Hydrographical work.*—Periodical surveys of the Lagos Bar were made for the Marine Department; and in conjunction with the Commander of the s.y. "Ivy," an extensive survey of the Opobo Bar was carried out.

(*e*) *Map production.*—Six sheets of the preliminary survey on a scale of $\frac{1}{125000}$ were published during the year. These sheets are of a provisional character.

(*f*) *Expenditure.*—The estimated expenditure for the year was £12,159, but the exact figures of the actual expenditure are not yet available.

(*g*) *General.*—A Survey School was established in July, 1908, to which seven pupils are admitted annually. The progress of these

pupils is satisfactory, and it is anticipated that after the stipulated three years' course, they will be sufficiently advanced to fill subordinate posts in the Survey Department.

Mr. E. P. Cotton left the Department in May, 1910, and Major F. G. Guggisberg, C.M.G., R.E., has been appointed his successor.

(*h*) *Re-organization.*—A scheme for the re-organization of the department is under consideration.

Intelligence Department.

The general map of the Central and Eastern Provinces, which was compiled last year, is now published. This map gives a large amount of information in a clear manner, and should be of value to both civil and military authorities.

In addition, Captain Beverley has compiled a wall map of the whole Protectorate, showing the Provincial Boundaries and Headquarters, chief towns lettered according to their populations, main roads, railways, telegraphs, post and telegraph offices, and chief waterways. This map will shortly be published.

It is satisfactory to be able to report very favourably on Captain Beverley's work.

SIERRA LEONE.

Governor ... ... Sir Leslie Probyn, K.C.M.G.

No survey work has been carried out in the field during the past year.

A general revision of the $\frac{1}{250000}$ sheets of this Colony is in hand, and all recent sketches will be incorporated in the new edition. Five sheets will be published shortly.

A map of the Karina District by Dr. J. C. Maxwell has been published in six sheets on a scale of $\frac{1}{125000}$.

SOUTH AFRICA.

General State of the Military Surveys.

The topographical surveys of Cape Colony and Orange River Colony have been steadily progressing during the past year, and a manœuvre area of some 8,500 square miles in the Transvaal is being surveyed.

The total area topographically surveyed in the field during the past five years in the Cape Colony, the Orange River Colony, the Transvaal, and Basutoland, amounts to rather more than 140,000 square miles.

BASUTOLAND.

The reconnaissance survey of Basutoland was completed in 1908–9 by Captain Dobson, R.F.A. The map will be produced in degree sheets on the $\frac{1}{250000}$ scale. One of these sheets is already published and the remaining three are in process of reproduction.

CAPE COLONY.

During the year an area of 15,292 square miles has been completed in the field. This brings the total area surveyed, since the commencement of the reconnaissance survey, up to 87,292 square miles.

Twelve sheets on a scale of $\frac{1}{250000}$, representing an area of 32,000 square miles, have been published and are on sale.

The number of officers working in the field varied from six to eight. A reconnaissance party consisted of one seconded officer and one attached officer.

The seconded officers were :—

Captain R. B. Hopkins, Manchester Regiment.
„ A. C. L. H. Jones, Northd. Fusiliers.
„ H. R. Payzant, Lan. Fusiliers.
„ H. A. P. Littledale, K.O.Y.L.I.

The attached officers were :—

Captain J. F. Loder-Symonds, South Staffs. Regt.
* „ E. F. Shewell, R.F.A.
Lieut. M. F. Day, K.O.Y.L.I.
„ J. L. Lockhart, Hamp. Regiment.
* „ G. E. Todd, Welsh Regiment.

The number of working days spent on reconnaissance (including treking) amounted to 1,437, which gives an output per officer of 10½ square miles per working day.

The topographical work was based on a graphic triangulation, and this has been extended in advance over four sheets.

The work was directed by Major H. W. Gordon, R.E., who will shortly hand over to Captain R. B. Hopkins, Manchester Regiment.

Major Gordon and the officers mentioned above have carried on the reconnaissance survey in a systematic and workmanlike manner.

ORANGE RIVER COLONY.

The topographical survey of the Orange River Colony, which is being carried out by the Colonial Survey Section of the Royal Engineers, under the command of Capt. H. St. J. Winterbotham, R.E., assisted by Lieut. A. G. McNeill, R.E., has made excellent progress during the past year.

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* These officers left before 31st March, 1910.

The total area mapped in the field since the commencement of the survey in December, 1905, amounts to 37,000 square miles, which gives a daily output of 23·4 square miles. During the past year 11,574 square miles of this total have been completed in the following sheets:—

Boshof, Bloemhof and Kimberley, Brandfort, Ladybrand, and Bloemfontein.

The remaining un-mapped portion of the Colony, 13,570 square miles in area, will probably be completed in the field in 18 months.

The work on the whole has been in easy country for both triangulation and plane-tabling. In the Bloemhof sheet, however, the triangulation was difficult, owing to the long hogsbacks covered with bush, and to the generally restricted view.

The primary geodetic chains have been joined by a secondary area triangulation of 18-mile side, broken up by a tertiary triangulation of 4-mile side. In joining two primary chains 87 miles apart, the closing error was ·028″ in both latitude and longitude.

Captain Winterbotham and those working under him deserve great credit for the amount and accuracy of the work carried out during the year under review.

RHODESIA.

The map of Southern Rhodesia, compiled by the Surveyor General, was published in seven sheets on a scale of $\frac{1}{300000}$ in February, 1910.

TRANSVAAL.

In 1909 it was decided to map a manœuvre area of some 8,500 square miles in the region of Pretoria.

Captain C. St. B. Sladen, R.E., was put in charge of the work, and was assisted by Lieut. K. W. Lee, R.F.A., and some plane-tablers drawn from the two field companies, R.E., serving in South Africa.

Work was commenced on the 8th February, 1910, and up to the 31st March 600 square miles had been completed in the field. The whole manœuvre area contained six geodetic points and a chain of secondary triangulation points 35 miles long.

The party commenced work by supplementing the existing triangulation with a graphic triangulation executed with telescopic alidades. This method was soon abandoned as it was found that the wave motion of the air precluded the use of these instruments except in the evenings, and a rapid instrumental triangulation was adopted.

The rate of progress with the topography was slow, owing to the scarcity of fixed points and the inexperience of the plane-tablers in small-scale work. The smoke from the mines hampered both the plane-tabling and triangulation parties.

UGANDA.

Governor	Captain H. E. S. Cordeaux, C.B., C.M.G.
Director of Surveys	Mr. R. C. Allen.
Officer in charge of the Topographical Survey of Buganda.	Captain W. C. Macfie, R.E.

Staff of the Survey Department.

During the year 1909–10 the staff of the Land and Survey Department has undergone no alteration as regards numbers. It consists of :—

1 Director of Surveys.
12 European Surveyors.
1 European Clerk.
1 Indian Surveyor.
3 Clerks and Draftsmen.

The work at Headquarters, mainly connected with the Land Office, fully occupies the time of the Director and of one assistant. The staff available for the field is, therefore, 10 Europeans and one Indian. During 1909–10 one surveyor was employed on the surveys of townships and Crown Lands. The Cadastral survey was therefore carried on by 9 European surveyors and one Indian.

The Director was absent on leave for 6 months and the Deputy Director, Mr. W. V. Morris, was in charge for this period.

Health.

The health of the staff was most satisfactory.

The total number of days' illness reported is 73, of which 32 days were among the Europeans, and 41 among the Indians. There was no illness of a serious nature.

Area Surveyed (Cadastral).

The area over which theodolite observations were completed for the cadastral survey, during the year, was 512 square miles. Detail cadastral survey was completed over an area of 584 square miles during the past year.

The total area surveyed cadastrally in Buganda, up to the 31st March, 1910, is 1,867 square miles.

The progress made is very satisfactory, and the reasons for this are, (*a*) no disturbance of field parties for the carrying out of miscellaneous surveys, (*b*) the assistance given in boundary line cutting free of charge by the natives, (*c*) the increase in individual outputs due to the increased experience of the surveyors.

Miscellaneous Surveys.

The principal miscellaneous surveys carried out during the year were—the survey of Kakindu, the laying out of Iganga, Kalito, and Kamuli, the surveys of mission plots in Busoga and Buganda, and the marking of plots for lease or sale in various townships.

Finance. Land and Survey Department.

	£
Estimated Revenue for 1909–10	4,950
„ Expenditure for 1909–10	7,712

The approximate cost of the native estates surveys during the year was £7 6*s.* 10*d.* per square mile.

The approved estimates for 1910–11 provide for a reduction of two assistants in the survey staff. The reason for this is, not that the importance of the native estates survey is under-estimated, or that the value of the work of the cadastral staff is not appreciated, but that it is necessary for financial reasons to defer any attempt to deal more thoroughly with the estates survey until the general small-scale topographical survey is completed and out of the way.

The question of the creation of certain "permanent" appointments to the survey staff is under consideration.

Land Office.

The Director of Surveys and Land Officer in his report for the year states that enquiries with regard to land from persons outside the Protectorate show a marked diminution, but that locally the demand for land is increasing. He also remarks that "the definition of the rights of natives to land is still no nearer a solution except in Buganda. . . . The settlement of native claims to land, outside Uganda, cannot for financial reasons resulting in insufficient staff, be even considered, much less dealt with."

He reports that the staff of draughtsmen is inadequate to deal with the office work, and that there are heavy arrears. Arrangements are being made to provide another draughtsman.

The conduct of the Survey and Land Department reflects great credit on Mr. Allen, who reports favourably on all the members of the Department.

Topographical Survey.

In order to ensure definiteness of aim and rapidity of execution, and to free the Survey Department for its main duty of surveying native estates, a special military party was entrusted with the topographical survey on the scale of $\frac{1}{250000}$ of the "Kingdom" of Buganda. The party consists of Captain W. C. Macfie, R.E., in charge, Lieutenant H. L. D. Pennington, and six non-commissioned officers, R.E. This party is independent of the Survey Department and will be removed from Uganda as soon as its special work is finished.

The total area surveyed by this party up to the 31st March, 1910, was about 9,385 square miles. The work is excellent and Captain Macfie and those working under him are to be congratulated on the results. Uganda will soon be one of the best mapped of British tropical possessions. Two sheets of the work are in course of reproduction and will be published during the current year.

NYASALAND.

Governor ... ... Sir ALFRED SHARPE, K.C.M.G., C.B.
Director of Public Works ... Mr. T. I. BINNIE.
(The Public Works Department undertakes the surveys.)

THE WORK OF THE PAST YEAR.

(1) *General.*—Very little survey work has been undertaken during the year, owing to the pressure of work in other directions.

(2) *Trigonometrical Work.*—The Assistant Director of Public Works was engaged, during May, on the commencement of a trigonometrical survey of the Shire Highlands. A base line was laid off near Zomba, and 34 stations were chosen and beaconed. All beacons are of the quadripod form, those for the primary stations being constructed of squared timber, 13 feet in height, and having masonry pillars on which to stand the theodolite when observing. At the end of May the services of the Assistant Director were required elsewhere, and the work had to be left in abeyance before any measurements had been taken.

(3) *Topographical Work.*—No topographical work was executed during the year under report.

(4) *Cadastral Work.*—Surveys as under were undertaken and completed during the year:—

Five estates, covering an area of 1,560 acres.
The boundaries of the Railway Block at Limbo.
The Railway Block at Blantyre.

(5) *Map production.*—No maps have been published during the year. A large number of tracings and draftings generally were executed in the office for this and other departments.

V.

THE STATE OF THE SURVEYS

OF

CEYLON, CYPRUS, FIJI, JAMAICA, TRINIDAD.

CEYLON.

Governor ... ... Col. Sir H. E. McCALLUM, G.C.M.G., R.E.
Surveyor-General ... ... Mr. P. D. WARREN, C.M.G.

STAFF.

Surveyor-General
Assistant Surveyor-General.

Field.	*Office.*
9 Superintendents of Surveys.	7 Assistant Superintendents.
1 Superintendent of Surveys (temp.).	72 Clerks and Draughtsmen.
10 Assistant Superintendents.	101 " " (temp.)
16 " " (temp.)	152 Piece-workers.
1 Assistant Astronomer.	
31 Grade Surveyors.	
234 Supernumerary Surveyors.	

This represents an addition of over 100 to the field staff during the year under revision.

The Work of the Past Year.

(1) *Trigonometrical.*—During the year 48 secondary and minor trigonometrical points were established at an average cost of Rs. 703.

(2) *Topographical Branch.*—329 square miles were surveyed on the scale of two inches to one mile.

(3) *Cadastral Branch.*—A staff of 59 surveyors was employed on the survey of Crown lands, railway acquisitions, and town and water rate surveys, which included the settlement of 2,463 applications for special surveys.

The plane table has been brought into use this year for the demarcation of boundaries and subdivision of lots, required by the Settlement Department, with most satisfactory results, and its use will be extended immediately.

(4) *Office.*—At headquarters in Colombo, an effort has been made to bring all the machinery and processes up to date to enable the office to keep pace with the field parties, and it is believed that the process and allied branches are now complete with the necessary equipment. A rubber offset machine has been installed and should help to expedite the work of reproduction.

The process departments turned out by photozincography and other methods, 609,188 prints of all sorts during the year.

(5) *Map production.*—The under-mentioned maps were published by the Survey Department during the year:—

i. Agricultural map of the North Central Province.
ii. Map of Ceylon in four sections, scale 1 inch = 4 miles.
iii. Map of Ceylon, scale 1 inch = 24 miles.
iv. Harbour map.

(6) *Expenditure.*—

	Rs.
Personal emoluments	492,336
Revenue surveys	516,265
Topographical surveys	49,715
Special expenditure	12,071
Survey and settlement	174,454
Total	1,244,841
Amount allotted	1,515,885

CYPRUS.

High Commissioner ...	...	Sir CHARLES KING-HARMAN, K.C.M.G.
Acting Registrar-General	...	Mr. F. O. J. ONGLEY.
Chief Surveyor	...	Mr. G. DOUGLAS.

SURVEY STAFF.

1 Chief Surveyor.
1 Draughtsman.
3 Temporary Assistant Surveyors.
2 Students.

REGISTRATION STAFF.

1 Chief Registration Officer.
2 Field Clerks.
4 Clerks.
2 Valuers.

History of the surveys.—A two-inch to one mile topographical survey of the island (of which the area is 3,584 square miles) was executed by Captain H. H. Kitchener, R.E., assisted by Lieut. S. C. N. Grant, R.E., was completed in 1882, and published on the scale of one inch to one mile in 1885. There are 15 sheets, and the work of reproduction was carried out by Mr. E. Stanford.

Captain Kitchener left in 1882 and Lieut. Grant became director of the survey, and remained until 1888. During this period a registration survey was commenced, based on the previous survey. Detail was filled in with the compass. Village boundaries were shown and all natural features which the scale would permit. Captain Young succeeded Captain Grant, and the registration survey was continued until 1894, by which date the registration of 150 villages had been completed.

During a period of nearly 10 years no survey work was carried out, *i.e.*, until September 1903, when, by order of the High Commissioner under Ordinance V. of 1880, a survey was directed to be made. The Registrar-General was appointed to be the Director of Survey.

The new survey is on the scale of 25 inches to one mile, villages being plotted on a scale 50 inches to a mile. The work was commenced in the south-east corner of the Famagusta District. Each sheet of the new survey covers an area of 960 acres, or 1½ square miles. The intention is to complete the 25-inch survey of the island in 20 years. For this it will be necessary to survey about 180 square miles a year.

The information available is not at present sufficient to enable the Colonial Survey Committee to report upon the technical methods employed, or upon the accuracy of the results.

FIJI.

Governor	Sir EVERARD IM THURM, K.C.M.G., C.B.
Officer in Charge of the Trigonometrical Survey.	Mr. G. T. McCAW.

THE WORK OF THE PAST YEAR.

(*a*) *General.*—Captain C. H. Ley, R.E., the officer in charge of trigonometrical survey, was obliged on account of ill-health to leave Viti Levu in 1909, and eventually resigned his appointment. Mr. T. Rimmer carried on the work until 17th January, 1910, when Mr. G. T. McCaw landed in the island and assumed his duties as Captain Ley's successor.

The past year has been devoted to the general reconnaissance of the island of Viti Levu, the selection and beaconing of triangulation points, certain angular measurements, and the selection of a check base.

(*b*) *General reconnaissance.*—The general reconnaissance of the island was carried out by Mr. Rimmer, with the main object of choosing and beaconing the station points for the trigonometrical survey.

In the prosecution of this work the chief difficulties encountered were, the absence of roads or paths, the precipitous nature of the country, swollen streams, forest and cloud-topped hills, and absence of fresh food.

The scheme of triangulation for the whole island, with the exception of a small portion in the south-west, was established on a sound basis.

(*c*) *Triangulation points.*—During the year 36 stations were chosen and beaconed, and 20 were chosen but were not beaconed. Of these 56 stations, 35 are principal and 21 subsidiary triangulation points.

(*d*) *Check base.*—A check base has been chosen on the west coast, and a scheme for its connection with the main triangulation has been arranged. No measurements were taken.

(*e*) *Angular measurements.*—Angular measurements have been completed at six of the stations in the region of the check base.

Mr. Rimmer, who was in charge of the trigonometrical survey for the greater part of the year under review, has carried out much useful work in a sound and systematic fashion.

JAMAICA.

Governor ... ... Sir SYDNEY OLIVIER, K.C.M.G.
Surveyor-General ... ... Mr. COLIN LIDDELL.

STAFF.

Director-General.
2 Assistant Surveyors.
3 Clerks.
1 Typist.
91 Bailiffs and Headmen.

THE WORK OF THE PAST YEAR.

(*a*) *General.*—There is no distinct Survey Department in the Island; all necessary surveys are executed by the Crown Lands Department, the staff of which is given above.

The total expenditure of the department during the year was £8,238, of which only £404 was spent on surveys.

(*b*) *Trigonometrical work.*—None was executed.

(*c*) *Topographical work.*—None was executed.

(*d*) *Cadastral work.*—This work includes the surveys of lands forfeited to the Crown for non-payment of taxes, and the delimitation therefrom of tax-paid areas belonging to private owners, and of lands sold or purchased by the Crown. These surveys were, with two exceptions, closed traverses, showing closing errors of from 1 : 10,560 to 1 : 1,320. 131¼ linear miles were traversed during the year.

(*e*) *Map production.*—Thirteen maps of all the parishes of the Island have been prepared on a scale of one inch to one mile, modernised and revised from Robertson's maps of 1804, which are the only legal authority in existence as to Parochial Boundaries. The revised maps show roads, railways, properties, and parish and electoral divisions. Maps on a scale of four inches to one mile were also prepared of the Kingston and Liguanea District and of the Ferry District. A large number of other maps and plans were also prepared for the use of this and other departments, and to the order of the public and property owners, for the purpose of opening the boundary lines of properties.

TRINIDAD.

Governor ... ... Sir GEORGE R. LE HUNTE, K.C.M.G.
Engineer in charge of Surveys ... Mr. C. S. COCHRANE, B.A.
Superintendent of Trigonometrical Surveys. Mr. E. R. SMART.

Staff.—The staff of the Survey Department consists of :—

Engineer in charge of Surveys.

Crown Lands Branch :
2 Assistants.
4 Draughtsmen.
1 Clerk.

Trigonometrical Branch :
Superintendent of Trigonometrical Surveys.
3 Assistants.

Expenditure.—

	£
Crown Lands Department	8,080
Trigonometrical Department	2,400
Total	£10,480

Work of the Trigonometrical Branch.

(*a*) *Triangulation.*—During the year 1909–10, 14 new tertiary stations were established on which to base the topographical survey of the coast from Chaguanas to Chaguaramas. The maximum closing error allowed in any triangle was 12 seconds.

(*b*) *Topographical work.*—The topographical surveys were confined to the coast-line and adjacent country.

From Sans Souci to Maracas Bay (40 miles).
„ Caroni River to Port of Spain (2 miles).
„ Point Cumana to Chaguaramas (7 miles).

(*c*) *Cadastral work.*—Survey of the Ward of Guapo (24,000 acres), parts of which were divided into blocks of 5 and 10 acres.

Survey of part of the Ward of Laventille between the railway and the Caroni River (3,000 acres).

(*d*) *Special work.*—Some 15 500-acre blocks were set out in the Morne L'Enfer Reserve and adjoining Crown Lands, for applicants desirous of searching for petroleum.

(*e*) *Map production.*—No new maps were produced during the year.

General Note.

The Trigonometrical Department is responsible for not only the trigonometrical survey proper, but also for the topographical and a proportion of the cadastral surveys of the Island.

Since the establishment of the Trigonometrical Department in 1901, the expenditure of this department has been as under:—

	£
Trigonometrical Survey proper	9,287
Topographical and Cadastral Surveys ...	13,533
	£22,820

It is estimated that the future expenditure necessary to complete the survey of the Island, will be from £3,000 to £5,000, or a total expenditure of from £26,000 to £28,000.

The area of the Island is 1,754 square miles; assuming, therefore, that the total expenditure on surveys executed by the Trigonometrical Department will be £27,000, the cost of the survey per square mile would be about £12 10*s.*; this amount includes the cost of triangulation. Each trigonometrical station has cost about £23 to fix.

It is not very clear what is the exact meaning to be attached to the word "topographical" in the reports received. It is not known, for instance, whether hill features are shown on the maps.

The Colonial Survey Committee has not sufficient information to enable it to report upon the state of the surveys of the Island as a whole, whether as regards the trigonometrical framework, the state of the topographical maps, or the cadastral plans.

BRITISH HONDURAS.

Governor ... ... Colonel Sir E. J. E. SWAYNE, K.C.M.G., C.B.
Surveyor-General ... ... Mr. H. I. PERKINS, I.S.O.

General Note.—Proposals for a general reconnaissance survey of the colony have been received from the Governor, and are now under consideration.

STAFF OF THE LANDS DEPARTMENT.

Surveyor-General.	2 Forest Officers.
Assistant Surveyor-General.	1 Clerk.
4 Assistant Surveyors.	1 Draughtsman.

(1) *Cost.*—The cost of the department for the year under review was $21,301.

(2) *Trigonometrical and Topographical Surveys.*—No surveys of this nature have been carried out.

(3) *Cadastral.*—The work of the greatest importance was the re-survey of the town of Stann Creek, which has been urgently required for many years; this is still in progress. Another important piece of work was the commencement of the survey of the 7,000 acres of Crown land to be granted to the United Fruit Company of the United States at the end of the railway laid down in the Stann Creek.

In addition to the above, surveys were carried out as under:—

Monkey River.—1,021 acres in 37 sections were laid out, and 1,850 chains were cut to link up surveys.

Stann Creek.—The Stann Creek Railway survey was completed up to rail head, and the area of land to be expropriated was determined.

In addition, 147 acres in five parcels were laid out.

Corosal District.—661 acres were laid out in Consejo.

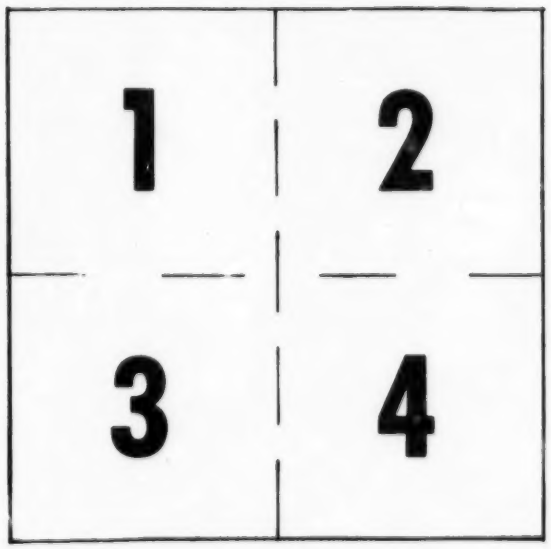
Cay Caulker.—189 acres were laid out, with 66 chains of traverse to link up surveys.

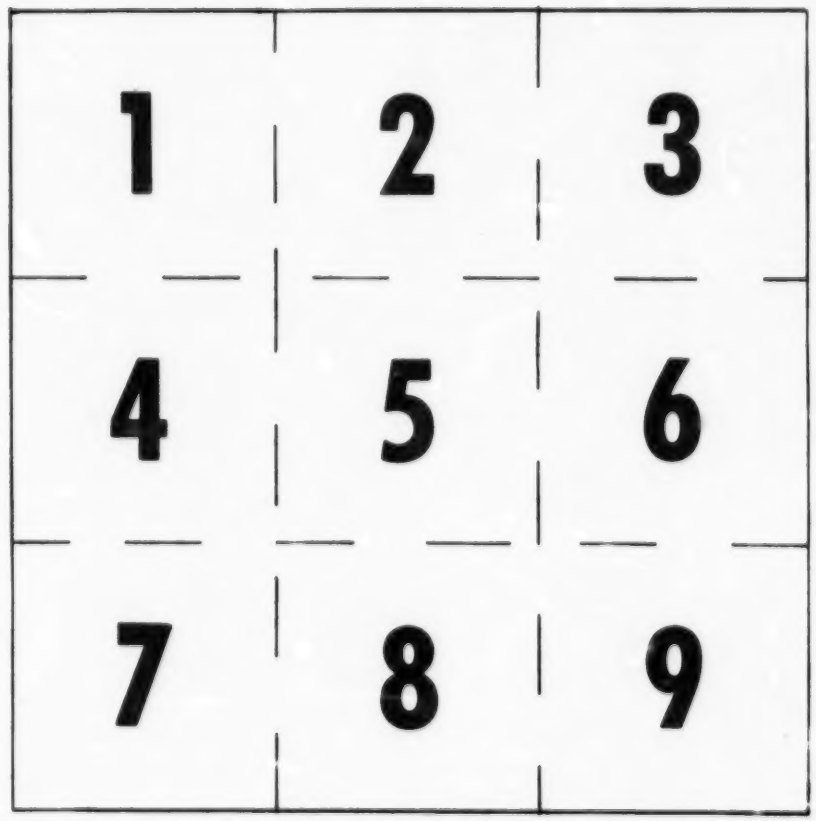
Western District.—2,936 acres in 49 parcels were surveyed. Three lots for a church and cemetery were laid out in Cayo Town. A report was furnished to the Public Works Department as to the best course of road to be adopted from the Cayo to Benque Viejo.

(4) *Map production.*—No maps were published during the year. 504 tracings were made for leases and grants, besides 183 other tracings and 21 plans.

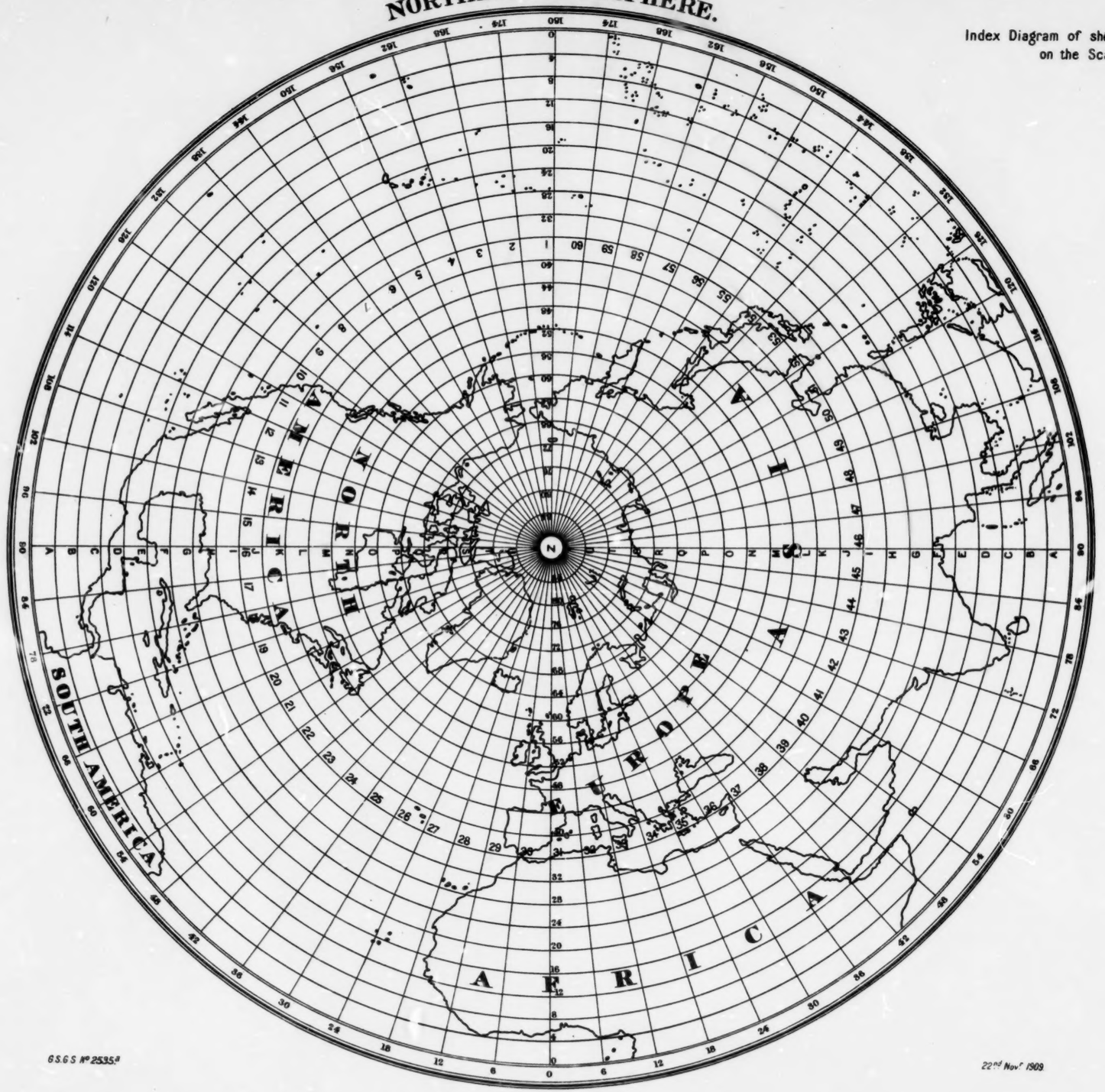
(5) *Revenue.*—The revenue of the year was $12,596.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.



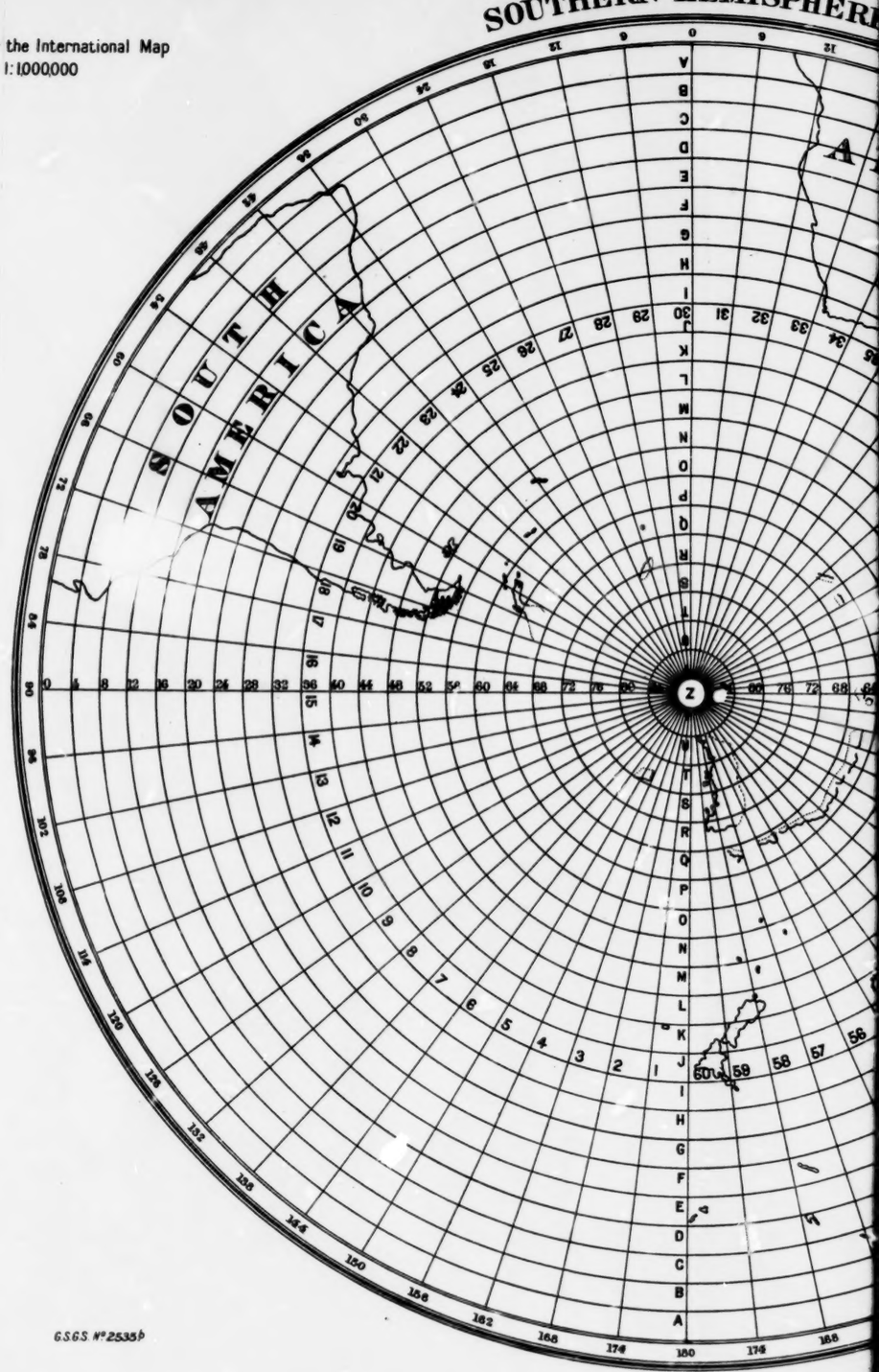


NORTHERN HEMISPHERE.



Index Diagram of sheets for the International Map
on the Scale of 1:1000000

SOUTHERN HEMISPHERE.

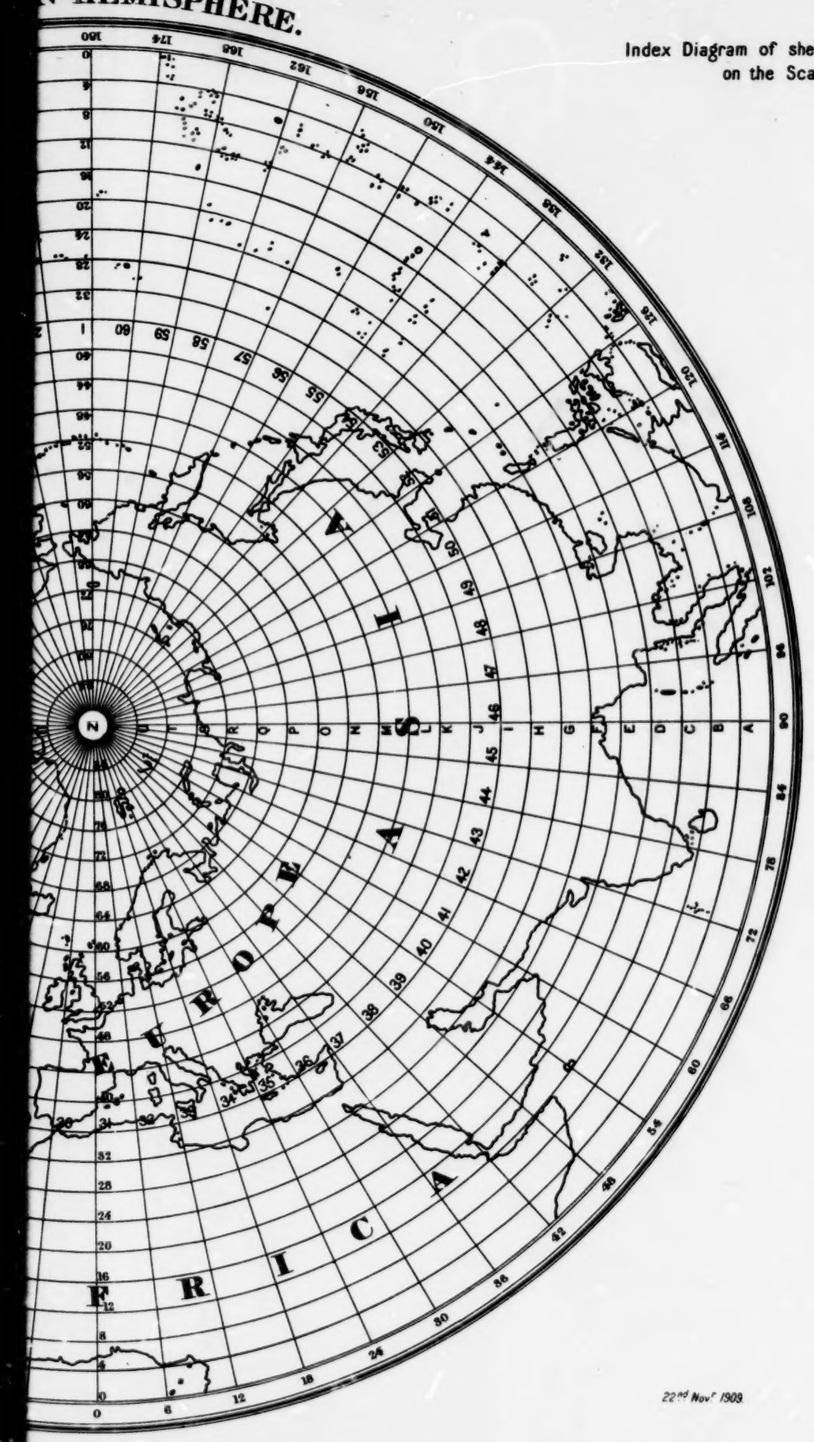


G.S.G.S. N° 2535a

22nd Nov. 1909

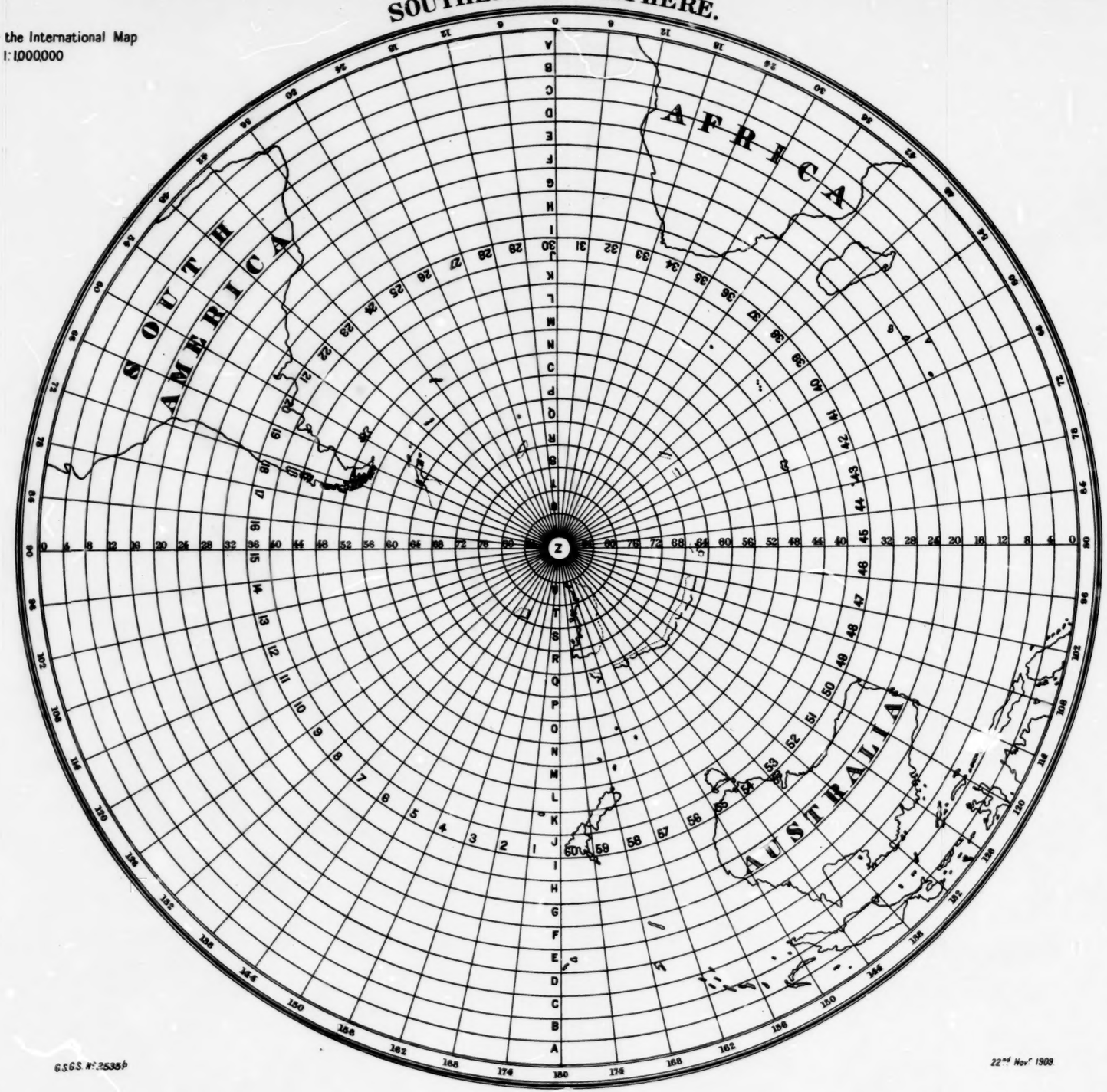
G.S.G.S. N° 2535b

N HEMISPHERE.



Index Diagram of sheets for the International Map
on the Scale of 1:1,000,000

SOUTHERN HEMISPHERE.



22nd Nov! 1909.

G.S.G.S. N°2535b

22nd Nov! 1909.

VI.

TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed	Dates of Finally approved.	REMARKS.
1	Gambia (Anglo-French)	425	Aug. 10th, 1889	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Lecomte, Civil Administrator.	Nov., 1890, to May, 1891	May, 1891	June 9th, 1891.	—	—
1	" "	—	" "	British :— Mr. Reeve. Mr. Ozanne. French :— M. Fargue. Lieut. de Jussien. M. Robert (Interpreter).	1895–6.	—	—	—	—
1	" "	—	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898–9.	—	—	—	—
1	" "	—	April 8th, 1904	British :— Major Cowie, W.I.R. Mr. B. B. de Tscharner.	1905–6.	—	—	—	—
2	Sierra Leone—French Guinea.	260	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Capt. A. H. Kenney, R.E. French :— M. Lamadon, Governor of the French Colony of Les Rivières-du-Sud.	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembi-Kunda.
2	" "	—	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Millot.	Dec., 1895, to May, 1896.	1895, 1896	April 9th and 30th, 1896.	June 14th and 16th, 1898.	From the Coast to Tembi-Kunda.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
2	Sierra Leone—French Guinea.	8	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Mr. Birch. French :— M. Lescure.	1900 and Jan. 15th, 1903.	1903.	Mar. 12th, 1903.	Exchange of notes, Mar. 22nd and April 5th, 1904.	Tembi-Kunda Eastwards.
3	Sierra Leone—Liberia ..	195	Nov. 11th, 1885	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E. Liberian :— Mr. J. McCarthy.	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	—	—
4	Gold Coast—Ivory Coast (Anglo-French).	450	July 12th, 1893	British :— Major A. E. G. Watherston, R.E. Capt. Soden, R. Fus. Capt. H. B. Des Voeux, R.E. French — M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903.	Feb. 1st, 1903.	May 11th and 15th, 1905.	—
5	Gold Coast, Northern Territories — French Sudan, Senegambia-Niger (Anglo-French Boundary North of Gold Coast).	195	Convention, June 14th 1898.	British :— Major A. E. G. Watherston, R.E. Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	—	Aug. 16th, 1901.	—	—
5	" "	"	Agreement, Mar. 18th/ April 25th, 1904.	British :— Capt. J. O'Kinealy. French :— Lieut. F. Verlaque.	—	1904.	Oct. 19th, 1904.	May 24th/ July 19th, 1906.	—
6	Gold Coast, Northern Territories — Togo (Anglo-German).	165	Convention, Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E. Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried	Dec., 1901, to Sept., 1902.	—	July 21st, 1902.	—	—

6	" "	"	"	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.	—	Sept., 1904, to Dec. 15th, 1905.	—	June 25th, 1904.	North of 9th parallel only.	—		
7	Gold Coast — Togoland (Anglo-German)	125	Convention, July 1st, 1890.	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	1904.	Oct. 11th, 1904.	—	In one exchange of notes.	From 9° N. Lat. to Niger.	From the Coast to 9° N. Lat. Treaty Series No. 15, 1899.	—
8	Lagos—Dahomey (Anglo-French).	235	June 14th, 1898	British :— Major J. I. Lang, C.M.G., R.E. French :— Commdt. Toutée.	1900.	—	Dec. 22nd, 1900, and Jan., 1905.	Oct. 19th, 1906.				
9	" " ..	200	August 10th, 1889, July 12th, 1893.	British :— Mr. F. C. Fuller. Mr. A. G. Fowler. Dr. Hay. French :— Capt. J. Plé. Lieut. Brisson.	1895-6.	—	Oct 12th, 1896, Art. II, June 14th, 1898.	Oct. 19th, 1906.				
9	" " ..			British :— Capt. Anderson. French :— M. Perreur.	1900.	—	—	—				
10	Niger—Chad (Anglo-French).	860	June 14th, 1898, April 8th, 1904.	British :— Lieut.-Col. G. S. McD. Elliott, R.E. Capt. C. H. Foulkes, R.E. Capt. G. R. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty. Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906, May 29th, 1906.	—				
10	" " ..	"	May 29th, 1906	British :— Major R. P. O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Andoin. Lieut. Vignon.	1906, 1907.	1907, 1908.	Feb. 25th, 1908.	—				

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	REMARKS.
11	Yola—Chad (Anglo-German).	350	Convention, Nov. 15th, 1893 Preliminary Agreement, Dec. 2nd, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E. Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B. Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Aug. 10th, 1903, Feb., 1903, to Feb., 1904 and 1905.	—	Feb. 24th, 1904, and Mar. 19th, 1906.	July 16th, 1906.	T aty Series, No. 17, 1906).
11	" "	40	" "	Local Commission to mark Boundary :— British :— Mr. Hans Fischer. German :— Leut. von Stephani.	—	1906 to 1907.	Feb. 12th, 1907.	Mar. 5th, 1909.	From Gorege to Lake Chad. (Treaty Series, No. 17, 1909).
11	" "	81	" "	British :— Capt. Vicars Boyle. German :— Capt. von Stephani.	—	1907.	Mar. 11th, 1907.	Mar. 5th, 1909.	From Uba, on Yedseram River, to River Benue.
12	Cross River (Southern Nigeria—Kameruns).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug. 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1895.	—	—	—	Cross River to the Sea.
12	" "	"	" "	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	—

13	Cross River Rapids—Yola Arc.	285	Nov. 15th, 1893	British :— Lieut-Col. G. F. A. Whitlock, R.E. Capt. H. T. G. Moore, R.E. Lieut. W. V. Nugent, R.A. 2nd Lieut. W. D. Downes, Royal Sussex Regiment. German :— Major Haering. Oblt. von Stephani. Oblt. Cuno. Oblt. Rothe.	Aug., 1907, to May, 1909.		April 16th, 1909.	—	—
14	Barotseland—Angola ..	710	Convention, July 11th, 1891, and Arbitration award, May 30th, 1905.	—	—	—	—	—	Not yet delimited.
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	—	—	—	—	—	Not yet delimited.
16	Bechuanaland—German South-West Africa.	1113	July 1st, 1890, Art. III. (A.G.); Dec 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British :— Major H D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1898 to 1903.	—	—	Part only of boundary delimited.
16	Cape Colony—German South - West Africa (Orange River).		July 1st 1890, Art. III.	—	—	—	—	—	Not yet delimited.
17	Amatongaland — Portuguese East Africa.	30	June 11th, 1891, Art. III	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	Aug., 1896, to Dec., 1896	—	—	—	—
17	" "	"	" " "	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	—	Aug. and Oct., 1897.	Oct. 2nd, 1897.	Dec. 29th, 1898/Jan. 25th, 1899.	—
18	Swaziland—Portuguese East Africa.	65	Conference, April to June, 1907.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1888, 1894, and 1897.	April, 1907	—	—	Portuguese and Boer Commission.

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS.
19	Transvaal — Portuguese East Africa.	255	July 29th, 1869. Convention of London, Feb. 27th, 1884.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major A. Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1887, 1890, and 1894.	1887, 1890, 1894.	—	—	Portuguese and Boer Commission.
20	Limpopo River to Sabi River (Anglo - Portuguese).	115	June 11th, 1891	British :— Mr. W. J. Atherstone. Portuguese :— José A Serrano.	Dec. 1902, to July, 1903.	—	Dec. 21st, 1903/July 19th, 1904.	June 3rd, 1907.	In one exchange of notes.
21	Mazoe or Manica Boundary (Anglo - Portuguese 18° 30′ S. to Sabi River).	235	June 11th, 1891, and Arbitral award, Jan. 30th, 1897.	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	June 3rd, 1907.	In one exchange of notes.
21	" "	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade.	—	1898, 1899.	June 5th and 28th, 1898, and Dec. 14th and 15th, 1898	—	—
22	Barue Boundary (Anglo-Portuguese, River Mazoe, and 18° 30′ South).	145	June 11th, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E. Portuguese :— Capt. Garcia Rosado.	1898.	1905	Dec. 28th, 1898.	Mar. and April, 1902, Jan. and April, 1904.	Exchange of notes.
23	Anglo-Portuguese Boundary South of River Zambesi.	215	" "	British :— Mr. Sawerthal. Portuguese :— Lieut. Durao.	1903-4.	—	—	—	Provisional survey.

23	"	"	215	"	"	..	..		April 1905, to Oct., 1905.	1905.	Oct. 4th, 1906.	—	—
24	Anglo-Portuguese Boundary North of Zambesi.		260	June 11th, 1891	..	..	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. S. Gugo Coutinho.		June, 1904, to Nov., 1904.	1904.	Nov. 21st, 1904.	—	—
25(a)	Nyasaland Protectorate —Portuguese East Africa (Anglo-Portuguese).		660	"	"	..	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. S. Gugo Coutinho.		July to Nov., 1899. Oct. to Dec., 1900.	1899–1900.	Dec. 8th, 1900.	*Sept. 15th, 1906.	Section from River Ruo to Lake Chiuta.
25(b)	"	"					British :— Mr. J. F. Cunningham. Mr. T. I. Binnie, Surveyor. Portuguese :— Capt. Ferraz. Conde. Du Pont. Capt. Branco. British :— Mr. A. James Swann. Mr. Thomas I. Binnie, Surveyor.						To make some alterations to previous line. Beaconed from B.P. 38 to Mt. Kapirinta.
25(c)	"	"	91	"	"	..	Local Commission :— British :— Mr. A. J. Swann. Mr. T. F. Firr, Surveyor. Portuguese :— 2nd Lieut. Antonio de Brito.		—	1907.	—	—	—
25(d)	"	"	—	June 11th, 1891	..	..	Local Commission :— British :— Mr. T. I. Binnie. Portuguese :— Ernesto Tavares D'Almeido Carvalho.		April-May, 1908.	—	May 22nd, 1908.	—	Ruo and Shire Rivers.
26	Nyasa-Tanganyika (Anglo-German).		225	July 1st, 1890	..	..	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Bolleau, R.E. Capt. Chichester. Lieut. Scratchley. German :— Hptmann Herrmann. Leut. Glauning. Dr. Kohlschütter.		1898.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—

* Provisional confirmation of recommendations of Boundary Commissioners, 1899 and 1900 (Procès Verbal, December 8th, 1900).

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	Remarks.
27	Congo Free State—North-West Rhodesia.	1,200	May 12th 1894	—	—	—	—	—	Not yet delimited.
28	Congo Free State—Uganda and Sudan.	800	May 12th, 1894, and May 9th, 1906.	British :— Lieut.-Col. R. G. T. Bright, C.M.G., Rifle Brigade. Capt. E. M. Jack, R.E. Lieut. Hon. F. R. D. Prittie, Rifle Brigade. Congolese :— Commandant E. Mercier, 2nd Regiment des Guides. Commandant J. Bastien, 2nd Regiment des Grenadiers. Commandant Stockhausen. Lieut. Weber. Lieut. Mauray.	Jan., 1907 to April, 1908.	—	—	—	—
29	British — German East Africa (Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith, R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 25th, 1893.	—	—
29	" " "	"	July 25th, 1893	British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897.	1900.	Jan. 2dth, Feb. 14th, and April 25th, 1900.	—	Not beaconed throughout its entire length.
30	British — German East Africa (South end of Jipe to Lake Victoria).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright, Rifle Bde. Lieut. T. T Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	—
30	German East Africa—Uganda.	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	July, 1902, to Apr. 1904.	1904.	July 18th, 1906.	—	—

31	Italian Somaliland — British East Africa.	375	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
31(*a*)	British Somaliland — Abyssinia.		May 14th, 1897, June 4th, 1897.	—	—	—	—	—	Not yet delimited.
32	British Somaliland — Italian Somaliland.	710	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
33	British Somaliland — French Somali Coast.	50	February 2nd, 1888 ..	—	—	—	—	—	Not yet delimited.
34	Uganda and East Africa —Abyssinia Boundary.	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900–01.	—	—	—	—
34	" " "	"	—	Capt. P. Maud, R.E. Mr. J. Baird.	Oct. 1902, to July, 1903.	—	—	—	—
34	" " ..	"	December 6th, 1907 ..	Major C. W. Gwynn, C.M.G., D.S.O., R.E. Capt. R. L. Waller, R.E.	1908. 1909.	1908. 1909.	—	—	—
35	Sudan—Abyssinia ..	760	Treaty, May 15th, 1902	Major H. H. Austin, R.E. Lieut. C. W. Gwynn, R.E.	—	—	—	—	—
35	" " ..	"	" " "	Brev.-Major C. W. Gwynn, R.E., D.S.O.	1903.	1903.	—	—	—
36	Sudan—Eritrea	330	December 7th, 1898, June 1st, 1899, April 16th, 1901, November 22nd, 1901, May 15th, 1902.	British :— Col. the Hon. M. G. Talbot, R.E. Italian :— Major Martinelli. Tenente. A. Pollera. Capt. Tornare.	1903.	—	—	—	R. Setit to Abu Gamal.
36	" " ..	"	" " "	Brev.-Major W. J. Walter, Lancs. Fus.	1899, 1901.	—	—	—	From Sabderat North - Eastwards.
37	Anglo - French — From Congo-Nile Watershed to Tripoli.	1,950	March 21st, 1899 .. Treaty, Series 15, 1899.	—	—	—	—	—	Not yet delimited.
38	Egypt—Tripoli	1,000	—	—	—	—	—	—	Not yet delimited.
39	Egypt—Turkish, Sinai Peninsula.	140	Firman, 1841	British :— Capt. R. C. Owen. Mr. Wade. Mr. Keeling. Turkish :— Mazzaffer Bey. Fehim Bey.	1906.	1906.	—	Oct. 1st, 1906.	—

VII.

CLASSIFIED LIST OF THE STAFFS OF SURVEY DEPARTMENTS.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	EAST AFRICA PROTECTORATE.				
	Superintending Staff.				
Director of Surveys	Major G. E. Smith, C.M.G., R.E.	800	... ...	1½ years	26th June, 1909.
Clerk and Storekeeper ...	Mr. A. Rhem	250	... ...	... ...	4th Jan., 1906.
Assistant Clerk	Mr. E. Rhem	72	... ...	... ...	1st Jan., 1909.
	Trigonometrical Branch.				
Deputy Director of Surveys ...	Capt. G. S. Knox, R.E. ...	667	... ...	3 years	16th March, 1909.
Assistant „ „ ...	Lieut. A. M. Coode, R.E. ...	525	... ...	„	9th May, 1909.
„ „ „ ...	Capt. G. C. Williams, R.E. ...	525	... ...	„	6th Nov., 1908.
Surveyor	Corpl. J. Healy, R.E.	300	... ...	„	1st Jan., 1910.
„	L.-Corpl. J. Rimmer, R.E. ...	215	... ...	„	20th Jan., 1909.
„	L.-Corpl. H. Thornton ...	200	... ...	Until 31st May, 1913 ...	15th July, 1908.
„	L.-Corpl. J. Durkan, R.E. ...	200	... ...	3 years...	15th July, 1908.
„	L.-Corpl. Garvey, R.E. ...	215	... ...	„	March, 1909.
„	L.-Corpl. Hursey, R.E. ...	200	... ...	„	1st Jan., 1910.
	Cadastral Branch.				
Deputy Director of Surveys...	Mr. A. E. Townsend	500	... ...	„	28th Dec., 1908.
Assistant „ „ ...	Mr. T. H. Galbraith	400	... ...	„	28th Dec., 1908.
District Surveyor „ ...	Mr. J. P. Clark...	380	... ...	„	1st April, 1907.
„ „	Mr. J. T. Stiles...	360	... ...	„	28th April, 1908.
„ „	Mr. F. H. Jordan	360	... ...	„	1st March, 1909.
Senior Staff Surveyor... ...	Mr. L. H. Lloyd	320	... ...	„	1st April, 1907.

" " "	Mr. G. Woodruff	320	... ...	"	21st July, 1906.
" " "	Mr. W. Nightingale	320	... ...	"	1st April, 1907.
" " "	Mr. F. M. Lamb	320	... ...	"	31st May, 1907.
Junior Staff Surveyor... ...	Mr. E. K. Boileau	250	... ...	"	10th July, 1907.
" " "	Mr. A. Bessler	250	... ...	"	3rd Sept., 1908.
" " "	Mr. J. Marsengo	265	... ...	"	10th Nov., 1906.
" " "	Mr. J. Spalding...	265	... ...	"	31st May, 1907.
" " "	Mr. D. G. Crofts	265	... ...	"	27th Sept., 1907.
Chief Draughtsman	Mr. C. Panting	200	£40 house allowance	"	14th Sept., 1906.
Chief Accountant	Mr. E. W. Nicholls	150	" " "	2½ years	7th Jan., 1909.
Assistant Accountant... ...	Mr. W. T. West	140	" " "	3 years	4th July, 1908.
Draughtsman	Mr. D. E. W. Ashe	160	... ...	Temporary	14th Feb., 1909.
Assistant Junior Staff Surveyor.	Mr. H. C. Anderson	100	... ...	3 years	5th August, 1909.
10 Indian Surveyors and Draughtsmen.	... ...	713 (total for the 10 men).	... ...	Temporary	—
2 Native Assistant Surveyors	Vacant	48 (total for 2 men).	... ...	"	—
Clerk, Goanese...	S. X. Pinto	72	... ...	"	18th Sept., 1907.
" "	A. J. de Mello	64	... ...	"	1st Dec., 1906.

GOLD COAST.

Director of Surveys	Capt. E. F. W. Lees, R.E. ...	700	£140 duty allowance, £36 horse allowance.	3 years on probation. Pensionable.	4th Jan., 1908.
Chief Surveyor	L.-Corpl. G. V. Mathieson, R.E.	250–10–300	10*s.* per diem travelling allowance.	" " "	" "
Surveyor	2nd Corpl. R. N. Kilby, R.E....	250–10–300	" " "	" " "	" "
"	L.-Corpl. A. J. Jones, R.E. ...	250–10–300	5*s.* per diem field allowance.	" " "	19th June, 1909.
"	L.-Corpl. A. Evans, R.E. ...	250–10–300	" " "	... ...	2nd Feb., 1910.
"	Sapper J. R. A. Miller, R.E. ...	250–10–300	" " "	... ...	" "
"	L.-Corpl. G. F. Spice, R.E. ...	250–10–300	" " "	... ...	—

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	GOLD COAST—*continued.*				
Draughtsman	L.-Corpl. A. F. R. Morris, R.E.	250–10–300	5*s.* per diem field allowance.	... ...	—
Native Surveyor	Mr. J. B. Esuman-Gwira ...	200–10–250	4*s.* per diem tent allowance.	3 years on probation. Pensionable.	1st Jan., 1908.
Native Assistant Surveyor ...	Mr. E. J. Smith	120–5–150	1*s.* per diem tent allowance.	" " "	" "
" " " ...	Mr. T. H. Vaughan	120–5–150	" " "	" " "	" "
Native Draughtsman	Mr. R. Josiah	120–5–150	... ...	" " "	" "
4th Grade Clerk	Mr. A. F. Benson	60–5–80	... ...	" " "	" "
	NORTHERN NIGERIA.				
Intelligence Officer	Capt. H. N. Kempthorne, Rl. Scots Fus.	400–20–500	£48 duty allowance, 2*s.* 6*d.* per diem horse allowance.	... ...	14th July, 1906.
Draughtsman	Lce.-Corp. A. J. Turner, R.E.	200	£20 outfit allowance, 1*s.* per diem bicycle allowance.	... ...	July, 1909.
Native Cartographer	Mr. O. Gilbert	200	... ...	Permanent	1901.
Native Draughtsman	Vacant	... ...	... ...	... ...	—
	SOUTHERN NIGERIA.				
Director of Surveys	Major F. G. Guggisberg, C.M.G., R.E.	900	£180 duty allowance	Pensionable	1st April, 1910.
Deputy Director of Surveys...	Mr. A. Cleminson	400–20–500	" " "	"	29th Oct., 1906.
Senior Surveyor	Mr. D. R. Meldrum	400	£80 duty allowance	"	13th March, 1909.
Surveyor	Mr. F. W. H. Black	390	... ...	"	23rd Sept., 1905.

... ...	Mr. R. A. Webb	390	... ...	... ...	13th Oct., 1906.
Temporary Surveyor	Mr. R. L. Drouyn	350	... ...	Not pensionable, by agreement.	
,, ,, ...	Mr. E. N. Thomas	350	... ...	,, ,, ,,	16th May, 1908.
,, ,, ...	Mr. J. Scott	350	... ...	,, ,, ,,	6th June, 1908.
Draughtsman	Mr. C. H. Sweney	350	... ...	,, ,, ,,	13th Feb., 1909.
European Instructor, Survey School.	Mr. W. F. Hole...	450	... ...	,, ,, ,,	17th Feb., 1909.
	UGANDA.				
	Cadastral Survey.				
Director of Surveys	Mr. R. C. Allen	500–700, by £25.	... ...	... ...	30th Nov., 1900.
Deputy Director of Surveys ...	Mr. W. V. Morris	325–425, by £20.	... ...	... ...	27th July, 1902.
Senior Surveyor	Mr. E. Richardson	360–20–400	... ...	3 years' agreement (Re-engaged for 3 years).	8th April, 1904.
,, ,, ...	Mr. E. G. Fenning	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
,, ,, ...	Mr. L. R. Fraser	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
Junior Surveyor	Mr. A. Richardson	300	... ...	3 years' agreement (Re-engaged for 30 months).	1st June, 1903.
,, ,, ...	Mr. J. T. W. S. McGregor ...	300	... ...	3 years' agreement (Re-engaged for 3 years).	17th July, 1903.
,, ,, ...	Mr. H. Boazman	350	... ...	3 years' agreement (Re-engaged for 30 months, 12/2/07).	17th July, 1903.
,, ,, ...	Mr. J. P. Tolland	300	... ...	3 years' agreement from date of arrival in Africa (not reported).	—
,, ,, ...	Mr. A. H. Gee	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. V. F. Mayne	300	... ...	,, ,, ,,	—
,, ,, ...	Mr. W. A. Khan	?	... ...	,, ,, ,,	—

UGANDA.

Topographical Survey.

Name.	Salary.	Allowances.	Tenure of Appointment	Date of present Appointment.
Capt. W. C. Macfie, R.E.	£ 667	£50 charge allowances	2 years	30th Dec., 1908.
Lieut. H. L. D. Pennington, R.E. ...	526	—	"	30th Dec., 1908.
Lce.-Corpl. J. H. Laverack, R.E. ...	11*s.* 1*d.* per diem, inclusive of allowances	—	"	30th Dec., 1908.
" H. O. Jones, R.E. ...	" " "	—	"	30th Dec., 1908.
" W. J. Whitters, R.E. ...	" " "	—	"	30th Dec., 1908.
" W. McDiarmid, R.E. ...	" " "	—	"	30th Dec., 1908.
" W. Richardson, R.E. ...	" " "	—	"	30th Dec., 1908.
" Gee, R.E.	" " "	—	"	5th June 1909.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	NYASALAND.				
Director of Public Works and Survey.	Mr. T. I. Binnie	450–600, by £25.	£100 personal ...	Permanent	15th March, 1897.
Assistant Surveyor	Mr. T. J. Firr	325–425, by £20.	£12 10*s.* electric light.	"	26th April, 1902.
" "	Mr. J. Bannerman	325–425, by £20.	" " "	"	1st June, 1901.
" "	Mr. G. N. Beaumont	200–300, by £10.	" " "	Temporary agreement...	5th Dec., 1905.
Clerk	Mr. E. Taylor	200–300, by £10.	£20 subsistence ...	... ...	6th July, 1906.
"	Mr. H. R. Cruise	200–300, by £10.	" " ...	... ...	25 Oct., 1906.
	CYPRUS.				
Chief Surveyor	G. A. Douglas	175	... ...	Permanent	1 April, 1905.
Surveyor and Draughtsman ...	Mehmed Salim	130	... ...	"	1 Dec., 1896.
	JAMAICA.				
Surveyor-General	Mr. Colin Liddell	500	Actual travelling expenses.	Permanent	1st Oct., 1890.
Assistant Surveyor	Mr. W. A. Baker	250–10–300	" " "	"	1st April, 1903.
" "	Mr. H. D. Rogers	200	" " "	Temporary	17th April, 1905.
2nd Class Clerk	Mr. W. M. Fraser	120–10–200	£30 " personal allowance.	Permanent	1st Oct., 1890.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	JAMAICA—*continued.*				
Assistant Clerk	Mr. V. N. Smith	78-5-100	... ...	Permanent	19th Feb., 1909.
Typist	Mr. R. N. Perkins	52	... ...	Temporary	26th July, 1909.
Clerk	Mr. G. L. Campbell	26	... ...	„	21st May, 1909.
	TRINIDAD.				
	(*Crown Lands Department.*)				
Engineer in charge of Surveys	Mr. C. S. Cochrane, B.A. ...	500	Travelling allowance £100, Supervision Trigonometrical Survey £100.	... ...	1st July, 1879.
1st Assistant	Mr. R. Kernahan	350	Travelling allowance £100.	... ...	1st Jan., 1898.
2nd „	Mr. J. W. Dumanoire	250	„ „ „	... ...	10th Nov., 1903.
1st Draughtsman	Mr. T. Sorzano	225	Personal allowance £75.	... ...	18th July, 1874.
2nd „	Mr. Th. Sorzano	125–150	... ...	... ...	12th Nov., 1881.
3rd Draughtsman	Mr. F. M. Sorzano	100–125	... ...	... ...	1st April, 1907.
4th „	Mr. A. W. Hunt	75–100	... ...	... ...	„ „
Clerk	Mr. W. B. Smith	100	... ...	... ...	1st July, 1907.
	(*Trigonometrical Department.*)				
Superintendent of Trigonometrical Surveys.	Mr. E. R. Smart	600	Field allowance 15*s.* per diem.	... ...	1st April, 1901.
1st Assistant	Mr. J. W. Macgillivray ...	250	Field allowance 12*s.* 6*d.* per diem.	... ...	„ „
2nd „	Mr. J. G. Reece	175	Field allowance, 8*s.* 4*d.* per diem.	... ...	1st April, 1904.
3rd „	Mr. C. E. Laurie	150	Field allowance, 6*s.* 3*d.* per diem	... ...	1st Aug., 1903.

LIST OF STAFFS.

Office.	Name.	Salary.	Date of First Appointment.
	BRITISH HONDURAS.		
		$	
Surveyor-General ...	Mr. H. I. Perkins, I.S.O.	3,402	18th Oct., 1905.
Assist. Surveyor-General	Mr. W. H. Carlin ...	1,944	1st April, 1896.
Assistant Surveyor ...	Mr. W. Cunningham ...	1,701	15th Oct., 1906.
" " ...	Mr. F. W. Brunton ...	1,458	18th Nov., 1903.
" " ...	Mr. C. la T. Franks, B A.	1,458	25th Feb., 1907.
" " ...	Mr. L. E. Williams ...	1,458	1st Jan., 1906.
Forest Officer	Mr. J. L. Brown ...	600–60–900	1st June, 1896.
" "	Mr. G. Hulse	600–60–840	1st Jan., 1910.
2nd Class Clerk	Mr. D. Rosado	480–30–720	16th May, 1907.
Draughtsman	Mr. E. Lassen	360–20–480	1st Dec., 1909.
	CEYLON.		
Surveyor-General ...	*Mr. P. D. Warren, C.M.G.	Rs.12,750–15,937·50.†	5th Jan., 1878.
Assist. Surveyor-General	*Mr. R. S. Templeton ...	Rs.9,000–11,250.	15th Oct., 1887.
		£	
Superintendent, Trigonometrical, &c.	*Mr. H. O. Barnard ...	500–600	4th Dec., 1890.
Superintendent, Application Surveys, &c.	*Mr. W. C. S. Ingles ...	500–600	4th Jan., 1890.
Superintendent, Topographical Surveys.	*Mr. A. J. Wickwar ...	500–600	1st Sept., 1889.
Superintendent, Waste Lands Surveys.	*Mr. J. B. M. Ridout ...	Rs.7,312·50‡	1st Nov., 1888.
		£	
... ...	*Vacant	500–600	—
Superintendents of Surveys.	*Mr. L. Shipton ...	400–450	4th Sept., 1884.
" " "	*Mr. C. Meaden ...	400–450	1st Nov., 1890.
" " "	*Mr. A. H. G. Dawson...	400–450	16th Dec., 1895.
" " "	*Mr. H. Erskine ...	400–450	1st Mar., 1876.
" " "	Mr. C. F. W. Halliley ...	400–450	1st Mar., 1891.
Assistant Superintendents of Surveys.	*Mr. C. R. Lundie ...	300–350	13th Feb., 1904.
" " "	*Mr. J. W. Robertson ...	300–350	17th June, 1885.
" " "	*Mr. G. F. Hepponstall	300–350	23rd Sept., 1886.
" " "	*Mr. A. J. Stronach ...	300–350	30th June, 1906.
" " "	*Mr. A. E. Dirckze ...	300–350	1st Oct., 1889.
" " "	*Mr. D. Bloxham ...	300–350	5th Oct., 1907.
" " "	*Mr. G. K. Thornhill ...	300–350	15th July, 1901.
" " "	*Mr. C. H. Vince ...	300–350	13th June, 190
" " "	*Mr. F. J. Salmon ...	300–350	13th June, 1908.
" " "	*Vacant	300–350	—
" " "	Mr. J. A. Loram ...	300–350	30th July, 1908.
" " "	Mr. H. M. C. Ledger ...	300–350	13th June, 1908.
" " "	Mr. E. B. Manson ..	300–350	13th June, 1908.
" " "	Mr. R. W. E. Ruddock...	300–350	5th Nov., 1908.
" " "	Mr. N. B. Favell ...	300–350	6th May, 1909.
" " "	Mr. P. J. May	300–350	6th May, 1909.
" " "	Mr. F. L. Baker ...	300–350	6th May, 1909.
" " "	Mr. K. W. S. Mitchell...	300–350	6th May, 1909.
" " "	Mr. H. P. Harrison ...	300–350	20th May, 1909.
" " "	Mr. C. C. S. Stephenson	300–350	21st Oct., 1909.
" " "	Mr. B. S. Coventry ...	300–350	19th Nov., 1909.
" " "	Mr. H. O. Clark ...	300–350	21st Oct., 1909.
" " "	Mr. C. G. Peterkin ...	300–350	15th Jan., 1910.
" " "	Mr. B. C. Johnstone ...	300–350	21st Oct., 1909.
" " "	Mr. P. E. L. Gethin ...	300–350	1st April, 1910.

* Permanent appointment.
† Draws a non-pensionable allowance of Rs.1,800 per annum.
‡ Draws an allowance of Rs.1,000 per annum.

Office.	Name.	Salary.	Date of First Appointment.
	CEYLON—*continued.*		
		£	
Assistant Superintendent of Surveys.	Mr. L. G. O. Woodhouse	300–350	1st Aug., 1905.
Assist. Superintendents of Surveys (Field Staff).	Corpl. P. B. Lynch ...	250–300	22nd May, 1908.
" " "	Sapper F. D. Dainty ...	250–300	5th June, 1908.
" " "	Sapper G. A. Robertson	250–300	5th June, 1908.
Assist. Superintendents of Surveys (Office Staff).	Mr. W. W. A. Wall ...	300–350	5th Nov., 1908.
" " "	Corpl. H. W. Johnson ...	300–350	22nd May, 1908.
" " "	Lan.-Corpl. E. E. O'Leary	300–350	22nd May, 1908.
" " "	Corpl. W. F. Hawkesworth	300–350	18th June, 1909.
" " "	Lan.-Corpl. W. J. Pringle	300–350	18th June, 1909.
" " "	2nd Corpl. W. S. Maddams	300–350	18th June, 1909.
" " "	2nd Corpl. R. B. Crusher	300–350	18th June, 1909.
Assistant Astronomer ...	Mr. A. J. Bamford ...	350–380	31st Oct., 1908.
	FEDERATED MALAY STATES.		
Surveyor-General ...	*Col. H. M. Jackson (late R.E.).	1,200	28th Aug., 1908.
	Trigonometrical Branch.		
District Surveyor-General	*Mr. A. E. Young ...	780–900	28th June, 1902.
Assistant Superintendent	*Mr. W. A. Wallace ...	480–540	8th Feb., 1904.
" "	*Mr. F. R. Twiss ...	480–540	21st June, 1906.
Surveyor	Mr. V. A. Lowinger ...	420	10th Aug., 1906.
"	Mr. N. F. J. Haszard ...	420	27th Aug., 1906.
"	Mr. J. Mouat	420	27th Aug., 1906.
"	Mr. R. Goulding ...	420	25th May, 1907.
"	Mr. A. Cochrane ...	420	30th Nov., 1907.
	Topographical Branch.		
Assistant Superintendent	*Mr. E. W. Hedgeland	540–660	3rd Jan., 1907.
" "	*Mr. J. N. Sheffield ...	480–540	14th Sep., 1906.
	Revenue Survey Branch.		
Superintendent	*Mr. J. P. Harper ...	660–780	2nd Sep., 1889.
		$	
"	*Mr. G. M. Stafford ...	3,000–4,200	29th Oct., 1889.
		£	
"	*Mr. H. R. Shaw ...	660–780	27th June, 1890.
Assistant Superintendent	*Mr. A. F. Harper ...	480–540	25th Mar., 1887.
" "	*Mr. E. G. Wood ...	480–540	21st Dec., 1889.
		$	
Assistant Superintendent (Office).	*Mr. W. T. Wood ...	3,600	1st Jan., 1890.
		£	
Assistant Superintendent (Acting Superintendent).	*Mr. S. T. Debney ...	480–540	1st June, 1890.
Assistant Superintendent (in charge Kinta District).	*Mr. E. J. Kemplen ...	480–540	18th Dec., 1891.
Assistant Superintendent	*Mr. J. G. Koch ...	480–540	8th Jan., 1894.
" "	*Mr. W. H. Mackenzie	480–540	24th Jan., 1894.
" "	*Mr. R. W. B. Darke ...	540–600	20th Feb., 1896.
" "	*Mr. E. Sweney ...	480–540	22nd Sep., 1898.
" "	*Mr. E. E. P. Clare ...	480–540	1st May, 1899.
" "	*Mr. L. U. Stafford ...	480–540	1st Sep., 1900.
" "	*Mr. R. A. Crawford ...	480–540	27th Jan., 1901.

* Pensionable appointment.

Office.	Name.	Salary.	Date of First Appointment.
FEDERATED MALAY STATES—*continued.*			
***Revenue Survey Branch*—continued.**			
		£	
Assistant Superintendent	*Mr. J. Bowes	480–540	18th Jan., 1902.
" "	*Mr. E. W. Geyer ...	480–540	4th Feb., 1902.
" " (Acting Superintendent).	*Mr. G. M. Goodyear ...	480–540	1st May, 1902.
Assistant Superintendent	*Mr. F. J. Gore ...	480–540	23rd Jan., 1904.
" "	*Mr. C. J. Perkins ...	480–540	8th Feb., 1904.
" " (Office, Acting).	*Mr. F. A. Sugden ...	360–420	10th May, 1901.
Surveyor, 1st Grade ...	*Mr. G. A. Hodges ...	360–480	1st July, 1901.
" "	*Mr. A. A. Campbell ...	360–480	15th June, 1902.
Surveyor, 1st Grade (Acting District Surveyor).	*Mr. T. Le Fevre ...	360–480	1st Aug., 1902.
Surveyor	*Mr. O. E. Jansz ...	400	1st July, 1903.
Office Assistant	*Mr. R. Gillet	360–420	17th Aug., 1903.
Surveyor, 1st Grade ...	*Mr. E. C. Dew... ...	360–480	7th Mar., 1904.
" "	*Mr. R. L. Buckwell ...	360–480	30th Apr., 1904.
" "	*Mr. D. S. Richards ...	360–480	27th May, 1904.
" "	*Mr. H. J. Mackenzie ...	360–480	25th June, 1904.
Office Assistant	*Mr. W. H. Harsen ...	360–420	11th Nov., 1904.
Surveyor, 1st Grade ...	*Mr. F. S. Phillips ...	360–480	3rd Aug., 1905.
Surveyor	Mr. F. A. Wedde ...	420	30th June, 1906.
"	Mr. T. Dewar	420	11th July, 1906.
"	Mr. F. B. Sewell ...	420	3rd Oct., 1906.
"	Mr. J. H. Johnston	420	18th Oct., 1906.
"	Mr. B. Cooper	420	25th May, 1908.
"	Mr. W. A. Gummer ...	420	1st Nov., 1907.
"	Mr. O. Krook	420	3rd Jan., 1908.
"	Mr. A. P. Schreiber ...	420	3rd Jan., 1908.
"	Mr. R. V. Morris ...	420	22nd Feb., 1908.
"	Mr. W. N. Horne ...	420	4th Mar., 1908.
"	Mr. J. W. P. Logan ...	420	4th Mar., 1908.
"	Mr. E. A. Barbour ...	420	5th Mar., 1908.
"	Mr. A. P. Chesney ...	420	8th Mar., 1908.
"	Mr. W. R. C. Piers ...	420	12th Mar., 1908.
"	Mr. J. Griffiths	420	4th April, 1909.
" (on probation)	Mr. S. Bunting	420	26th June, 1908.
	Mr. C. Y. B. Sewell ...	360	7th Oct., 1908.

* Pensionable appointment.

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COLONIAL REPORTS.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
608	Colonial Survey Committee	1908–1909
609	Gambia	1908
610	Malta	1908–1909
611	Sierra Leone	1908
612	Turks and Caicos Islands	"
613	Gold Coast...	"
614	Bechuanaland Protectorate	1908–1909
615	Bahamas	"
616	St. Lucia	1908
617	Hong Kong	"
618	Fiji	"
619	Nyasaland Protectorate	1908–1909
620	Barbados	"
621	Trinidad and Tobago	"
622	Straits Settlements	1908
623	Somaliland	1908–1909
624	Mauritius	1908
625	St. Vincent	1908–1909
626	Jamaica	"
627	Swaziland	"
628	Grenada	1908
629	Leeward Islands	1908–1909
630	Southern Nigeria	1908
631	British Honduras	"
632	British Guiana	1908–1909
633	Northern Nigeria	"
634	Basutoland	"
635	East Africa Protectorate	"
636	Uganda	"
637	Weihaiwei	1909
638	St. Helena	"
639	Northern Territories of the Gold Coast	"
640	Ashanti	"
641	Gambia	"
642	Malta	1909–1910
643	Seychelles	1909

MISCELLANEOUS.

No.	Colony, &c.	Subject.
63	Imperial Institute	Gums and Resins.
64	Uganda	Botany and Forestry.
65	Do.	Sleeping Sickness.
66	Gold Coast	Forests.
67	Southern Nigeria	Mineral Survey, 1905–1906.
68	Do. Do.	Mineral Survey, 1906–1907.
69	St. Helena	Fisheries.
70	Colonies	List of Laws relating to Patents, Trade Marks, &c.
71	Imperial Institute	Foodstuffs.
72	Fiji	Hurricane.

COLONIAL REPORTS—ANNUAL.

No. 685.

THE SURVEYS

OF

BRITISH AFRICA, CEYLON, CYPRUS, FIJI, JAMAICA, TRINIDAD, BRITISH HONDURAS.

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

SIXTH YEAR.

To 31st March, 1911.

(For Report for 1909–10, *see* No. 644.)

Presented to both Houses of Parliament by Command of His Majesty.
August, 1911.

LONDON:
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LTD., FETTER LANE, E.C., and
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E. PONSONBY, LTD., 116, GRAFTON STREET, DUBLIN.

PRINTED BY
DARLING AND SON, LTD., BACON STREET, E.
1911.

[Cd. 5467-21.] *Price* 1*s.* 6*d.*

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No. 685.

COLONIAL SURVEY COMMITTEE REPORT.

FOR THE YEAR ENDING 31ST MARCH, 1911.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

S. C. N. GRANT, *Colonel, D.G.O.S.*
H. J. READ.
C. F. CLOSE, *Lt.-Col., Gen. Staff.*

W. C. BOTTOMLEY,
L. N. KING, *Captain, G.S.* } *Secretaries.*

August, 1911.

(20319—2.) Wt. 31959—459. 1125 & 85. 9/11. D & S. A 2

I.

REVIEW OF WORK IN AFRICA DURING THE PAST YEAR.

Topographical Surveys.—During the past year a total of about 54,000 square miles has been topographically surveyed in British Africa. The most important areas are :—

South Africa—	
Cape of Good Hope	12,630 sq. miles.
Orange Free State	12,596 „ „
Transvaal	7,900 „ „
East Africa	12,250 „ „
Uganda	4,115 „ „
S. Nigeria	2,579 „ „

General Maps.—Northern and Southern Nigeria.—A general map on a scale of $\frac{1}{2000000}$ with an index to place names has been published.

Rough Surveys and Explorations have been carried out in the Anglo-Egyptian Sudan, Northern Nigeria, East Africa, and Sierra Leone.

Geodesy.—The computations for the geographical co-ordinates of the stations of the arc of meridian in Uganda have been completed. The report on the work of the party employed on this work is in course of preparation.

Cadastral Surveys have been in progress in East Africa, the Gold Coast, Northern and Southern Nigeria, and Uganda.

Boundary Commissions :—

(i.) An agreement was signed at Brussels on the 14th May, 1910, dealing with the eastern frontier of the Congo, and with the Anglo-German frontier between Uganda and German East Africa, west of Lake Victoria.

A boundary commission has been appointed to delimit this frontier from Nkabwe to Sabinio, and also the Anglo-German frontier to the east of Sabinio. The commission left England in December, 1910, reached Nkabwe in February, 1911, and is now at work.

(ii.) The Commissioners employed on the boundary between Nigeria and the Kameruns, extending from Yola to the Cross River, have agreed upon a definite boundary, which, however, has not yet been formally sanctioned by the two Governments. The African General Service medal has been granted to the troops engaged in the fighting which took place in the Sonkwala Valley during the course of the delimitation of the boundary.

A general report on the work of this commission has been published, together with a report on the geographical features of the country through which the boundary passes.

(iii.) The boundary between Nigeria and the French Sudan, stretching from the Niger to Lake Chad, has been ratified since the close of the year under review.

II.

REGULATIONS AFFECTING SURVEY DEPARTMENTS.

Appointments to Survey Departments.

Note.—These regulations supersede those contained in the last report and are subject to revision from time to time.

The Secretary of State for the Colonies has approved of the following arrangements for the selection of candidates for junior survey appointments in Crown Colonies and Protectorates.

1. For the purpose of selecting surveyors, Ceylon, the Federated Malay States, and the East Africa and Uganda Protectorates will be grouped, and candidates will be required to pass the same tests and go through the same preliminary training. Candidates will, however, be allowed to indicate their preference for particular Colonies, and, if they wish it, to await the occurrence of vacancies. It is possible that other Colonies or Protectorates may be included in these arrangements in the future, but for the present they will apply only to the countries named, which are those in which vacancies may be expected to occur most frequently.

2. Candidates must be between the ages of 21 and 27 and should be unmarried, as the conditions of service for surveyors in the countries concerned are not suitable for a married man.

3. Anyone wishing to become a candidate for these posts should apply in writing to the Private Secretary to the Secretary of State, Colonial Office, London, S.W. He will be required to fill in a form of application and to furnish testimonials and the names of two referees. If the information thus obtained is considered satisfactory, he will be asked to call at the Colonial Office for a personal interview, and, if accepted, will be nominated as a candidate.

4. A candidate not exempted under paragraphs 5 or 6 of this Memorandum will be required to pass two tests:—

(*a.*) A qualifying examination in mathematics, including algebra, geometry, and plane trigonometry, and

(*b.*) A qualifying examination in the use and adjustment of surveying instruments. This examination will include the theodolite, level, compass, chain, tape, plane table, clinometer, and barometer. It is not, however, necessary that the candidate should have had other than academical experience of the use of these instruments.

For these examinations, which will be conducted at the Surveyors' Institution, an examiner nominated by the Secretary of State will be associated with the examiners nominated by the Institution. The candidate will be required to pay a fee of one guinea for each examination.

5. A candidate who has passed with honours in mathematics, physical science, or engineering, or who has obtained an equivalent diploma or distinction, in a University or school of a University

in the United Kingdom, or who has been licensed to practice as a Surveyor in one of His Majesty's Dominions, will not be required to undergo any technical or educational test.

6. A candidate who has passed the examination for the Associated Membership of the Institute of Civil Engineers or for the Professional Associateship or Fellowship of the Surveyors' Institution, or who has obtained the surveying diploma of the Royal Geographical Society, will be exempt from the technical test referred to in paragraph 4 (*b*) above.

7. Candidates who have passed the qualifying tests or have been exempted will then be required to undergo a medical examination by one of the medical advisers to the Colonial Office in London, Edinburgh, or Dublin. A fee of one guinea will be charged for this examination.

8. According to the number of vacancies, candidates will then be sent to the Ordnance Survey Office, Southampton, for a course of instruction not exceeding two months. If reported on favourably by the Director-General of the Ordnance Survey, but not otherwise, a candidate will become a Survey Probationer and will be granted the amount of his actual travelling expenses* incurred in connection with the course, and a lodging allowance of 2*s.* 6*d.* a day and a subsistence allowance of 5*s.* a day for each day spent at Southampton.

9. A Survey Probationer will be sent out to the Colony or Protectorate to which he is posted at a salary of £250 a year, with free quarters or an allowance in lieu thereof when stationed at headquarters. He will draw half pay on the voyage out and will not begin to draw full pay until his arrival in the Colony or Protectorate.

10. At the end of one year he will, if approved by the Surveyor-General or Director of Surveys, be appointed to the Department at the ordinary rate of pay attached to junior survey appointments. These rates of pay in the various Colonies or Protectorates are as stated in the following paragraph. The appointment will be for three or five years in the first instance, with a prospect of re-engagement if the Surveyor's service continues to be satisfactory and of ultimate appointment to the permanent establishment in the case of Ceylon and the Federated Malay States. In East Africa and Uganda only a few of the highest appointments in the Survey Department are permanent and pensionable.

11. The rates of salary payable after the expiration of the period of probation are as follows:—

Ceylon.—Assistant Superintendent of Surveys	£300 to £350 a year by annual increments of £10.
Federated Malay States.—Second-Grade Surveyor	£300 to £360 a year by annual increments of £15.
East Africa and Uganda.—Junior Staff Surveyor	£250 to £280 a year by annual increments of £15.

* Travelling expenses are not granted in respect of the candidate's call at the Colonial Office or his qualifying or medical examinations.

12. If at the end of a year's probation a Probationer is not approved, his appointment will be terminated, and he will have no claim to any compensation beyond a free passage back to England. The probationary period of one year may, however, be extended at the discretion of the Governor or High Commissioner if the extension is recommended by the Surveyor-General or Director of Surveys on account of special circumstances.

13. The Secretary of State does not by these arrangements preclude himself from considering an application for appointment from a Surveyor who is fully qualified in the practice of his profession but who is unable by reason of age to offer himself as a candidate for a Survey Probationership.

Colonial Office,
July, 1910.

The qualifying examination in Mathematics for candidates for Survey Probationerships in the Colonial Service will be conducted in accordance with the following syllabus :—

Algebra	Up to quadratic equations and problems involving their solution.
Geometry	Alternative papers will be set :— (*a.*) Euclid, first six books. (*b.*) Theoretical and practical Geometry up to an equal standard.
Mensuration ...	Areas of plane figures.
Plane Trigonometry	Up to the solution of triangles, with applications to heights and distances. The use of trigonometrical and logarithmic tables.

Three papers will be set: (I.) in algebra, (II.) in geometry and mensuration, and (III.) in plane trigonometry. Three hours will be allowed for each paper.

The questions in each paper will be arranged with a view to testing the candidates' ability and accuracy in arithmetical work.

One hundred marks will be allotted to each paper.

Candidates who obtain 165 marks in the three papers will be considered to have qualified.

It is to be understood that, while the examination is not competitive in the sense that the candidate who stands highest on the list will have any claim to priority of consideration, the marks obtained will be taken into account by the Secretary of State in comparing the merits of the various qualified candidates.

Colonial Office,
February, 1911.

III.

REPORTS ON THE SURVEYS OF BRITISH AFRICA.

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THE ANGLO-EGYPTIAN SUDAN.

Governor-General ...	Lt.-General Sir F. R. WINGATE, K.C.B., K.C.M.G., D.S.O.
Director of Surveys ...	Captain H. D. PEARSON, R.E.
Assistant-Director of Surveys	Captain A. E. CONINGHAM, R.E.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but it has been thought desirable to include an account of these surveys in order to make the review of the mapping of British Africa more complete.

During 1910 the Burun country south of Roseires, between the Blue and White Niles and the River Sobat, was explored by Captain Coningham. Latitude and azimuth observations were carried through the Tabi Hills, and the River Sobat was reached at Machar. A reconnaissance for a telegraph line to Gambela and Captain Coningham's survey down the river resulted in considerable revision of the course of the Sobat. Some further work east of Kodok and Melut has corrected the previous route sketches in this district.

Some triangulation was carried on in the Lado Enclave at the time of taking over from the Belgians, and a fair longitude obtained on the Congo-Nile Water Shed. A compass traverse between Yei and Meridi shows that the position assigned to the latter place is considerably in error, and Captain Coningham is now at work in this region. Numerous time and compass sketches in Kordofan and elsewhere have been received from province officials during the year. These sketches generally tend to show that further revision

of many of the sheets is valueless, without a much extended system of triangulation or astronomical positions. All information that has been received to date has been inserted on the Sudan sheets, adjusted often by little more than guess work, and rough maps of the whole of the Sudan have been issued. The time has now come for a more scientific mapping of the inhabited areas.

Revision of 40 sheets on the $\frac{1}{250000}$ scale have been made in 1910, and two new sheets of the million series, viz., Kordofan and the Northern Bahr-al-Ghazal are now in hand in Cairo, and will shortly be issued. Cadastral survey sheets along the river between Khartoum and Halfa have been reduced, and are being utilised in the revision of the topographical maps through which the river passes.

The cadastral survey of the whole of the river land to the North of Khartoum has now been completed, and over 800,000 acres of properties have been surveyed in detail in the Gezira between the Blue and White Niles to date. Some 40,000 acres of land cultivated at low Nile between Khartoum and El Dueim have also been mapped. Areas required for concession in Sennar, and on the Atbara have also been undertaken, while a survey of the country round Gedaref, on which rain crops are grown has been completed on a $\frac{1}{50000}$ scale.

The town survey of Omdurman on a scale of $\frac{1}{500}$ has almost been completed and that of Khartoum North is about to be put in hand.

124 sheets on the $\frac{1}{250000}$ scale are now published of the Sudan, about one-third of these have been reproduced by the War Office, one-third are published by the Survey Office, Khartoum from zinc plates, and the remainder are issued in Khartoum in the form of sunprints.

Cadastral survey of the important cultivated districts is now approaching completion, and in a year or two the establishment of the Survey Department will be reduced to a small permanent staff, who will be employed in keeping the cadastral maps up to date and extending the various local triangulations for the correction of the existing topographical sheets.

EAST AFRICA PROTECTORATE.

Governor	Colonel Sir E. P. C. Girouard, K.C.M.G., D.S.O.
Director of Surveys	Captain G. S. Knox, R.E.
Deputy Director of Surveys, Trigonometrical and Topographical Branch.	Captain G. C. Williams, R.E.
Deputy Director of Surveys, Cadastral Branch.	Mr. A. E. Townsend.
Assistant Director of Surveys, Trigonometrical and Topographical Branch.	Lieutenant A. M. Coode, R.E.
Assistant Director of Surveys, Cadastral Branch.	Mr. T. H. Galbraith.

(i.) Staff.

Superintending Staff.

Director of Surveys.	1 Clerk and Storekeeper. 1 Assistant Clerk.

Trigonometrical and Topographical Branch.

Deputy Director. 2 Assistant Directors. (1 vacancy.)	6 Surveyors (N.C.Os., R.E.).

Cadastral Branch.

Deputy Director. Assistant Director. 17 Surveyors. 1 Chief Carpenter.	2 Draughtsmen. 10 Indian Surveyors and Draughtsmen.

Health.—Except on the coast, where the surveyors suffered much from fever, and one Indian surveyor died, the health of the Department has been good.

(ii.) The Work of the Past Year.

The staff available for both triangulation and topography consisted of two officers and six N.C.Os., and of these one officer was employed for two months on special duty on the Anglo-Italian boundary.

(*a*) *Triangulation.*—An area of 5,964 square miles was covered by triangulation, and an additional area of 3,120 square miles was covered by intersected points. The average triangular error of the 38 major triangles was 1·59 seconds, and of 75 minor triangles 3·02 seconds.

The cost of triangulation was about 8·6 shillings per square mile. An account of the tertiary triangulation is given under "cadastral branch."

Preliminary reconnaissances were carried out in Laikipia where the work was easy, and also on the coast near Mombasa, where the country rendered it difficult to arrange a satisfactory scheme.

The districts in which triangulation was effected, and the positions of stations were computed and permanently marked were :—

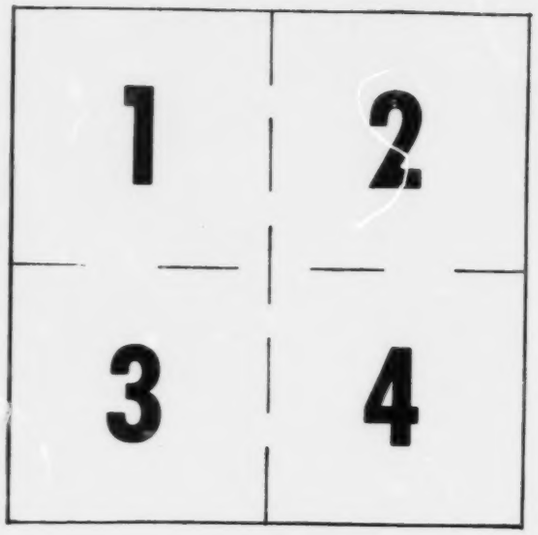
Laikipia. West of Lake Naivasha.	Plateau. Southern Coast District.

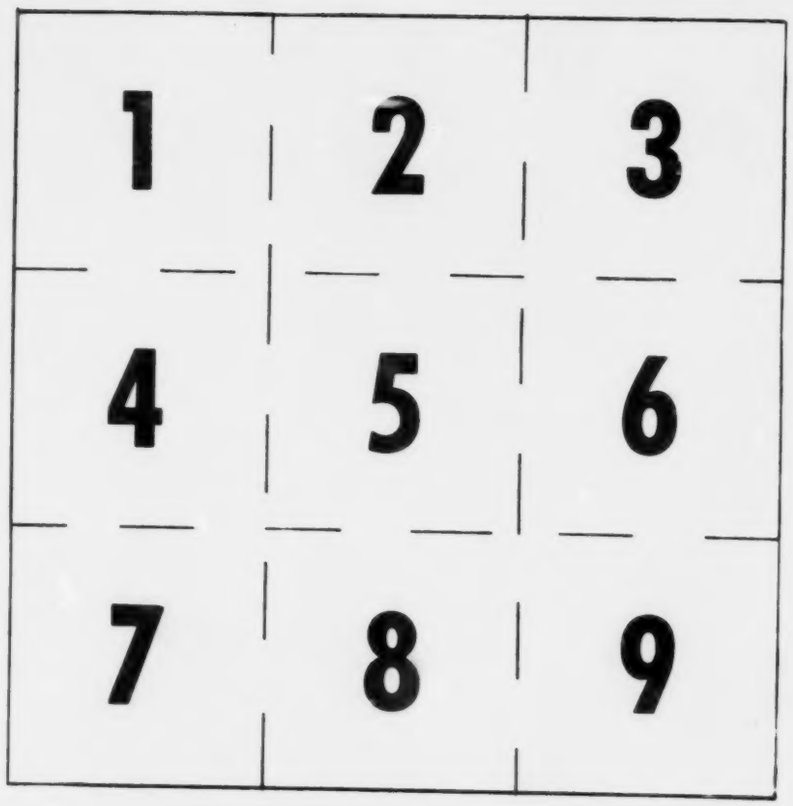
(*b*) *Topography.*—The work completed in the field on the scale of $\frac{1}{125000}$ amounted to 2,987 square miles, and included the following sheets :—

$\frac{South\ A.\ 37}{A.\ I}$ $\frac{South\ A.\ 37}{A.\ II}$ $\frac{South\ A.\ 37}{A.\ III}$ $\frac{South\ A.\ 37}{B.\ III}$

On the $\frac{1}{250000}$ scale, a good reconnaissance was made by Lieutenant Coode, R.E., of the country north of Kenya, and a portion of sheet $\frac{South\ A.\ 37}{A}$ was also surveyed on this scale. The total area mapped on this scale was 8,575 square miles.

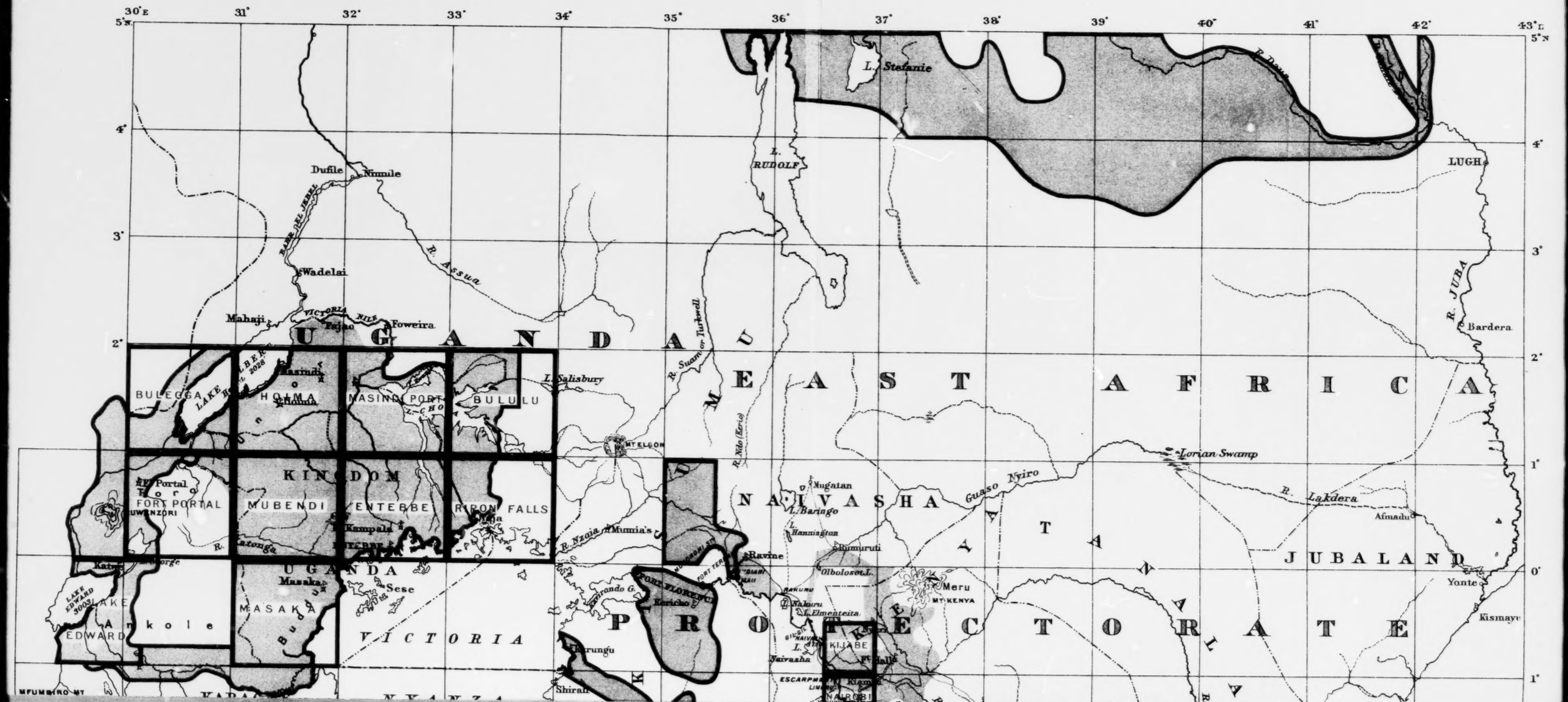
Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA



EAST AFRICA

REFERENCE

Telegraph lines
Railways
Cart roads
Cleared (Trade) routes
Caravan tracks
Gov.t Stations

Geographical Section, General Staff; No 2291.

Revised, May 1911.

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

On the $\frac{1}{63360}$ scale, about 688 square miles were mapped, this work was executed for the use of the Land Office. The cost of the topographical work was 6·5 shillings per square mile.

(*c*) *Cadastral Branch.*—The staff of this branch was much below establishment during the period under review, there being eight vacancies towards the close of the year, and consequently it has been impossible to make any progress with the arrears of work which the Department has in hand. These arrears now amount to 1½ million acres, and owing to the demand for land, this figure has a tendency to increase. Apart from additional work which must be expected in the future, the present staff will require four years to complete the arrears now in hand.

The largest surveys commenced during the year were :—

(i) The Gilgil Allotment ... ... about 89,000 acres.
(ii) The Londiani Allotment ... ... „ 81,000 „
(iii) The Kibigori-Muhoroni Allotment „ 60,000 „
(iv) The Mua Hills Allotment ... „ 23,000 „
(v) The surveys on the coast for registration of titles.

Tertiary triangulation (in connection with the cadastral work) covering 632,000 acres, has been completed during the year; the average triangular error being 7·6 seconds. All these tertiary points are permanently marked on the ground, and data for locating them are recorded.

Township surveys with 10 foot contours have been made, the total area thus surveyed amounting to 3,422 acres. These surveys were made to facilitate township design.

Traverses of a total length of 49,866 feet have been carried out with a closing error not exceeding 1 in 2,500.

A summary of the cadastral work completed is as follows :—

Tertiary Triangulation	632,005 acres
Township Surveys	3,422 „
Miscellaneous Surveys...	90,900 „
Cadastral Surveys	484,266 „
Traverses	49,866 feet

The cost of the cadastral surveys, including surveys for registration of title was 6·31 pence per acre.

Accounts Office.—The work of this office has been very heavy, as it has been working for many months under establishment. Recently the services of a European clerk have been obtained, to replace those of two Goanese clerks, and it is hoped that the work will be thereby expedited.

Drawing Office.—This office is now used as a show room for the public, where they may see maps, plans, &c., and this arrangement is not at all suitable, as draughtsmen are unable to work with continual interruptions. The provisions of a separate map room and curator is desirable.

Owing to the lack of staff, this office has been unable to cope with all the work required of it, which includes the following :—

All maps, plans, diagrams, &c. connected with survey work.
Title deeds and plans for settlers.

Recording and registering all applications for land.
Compiling general maps from sketches received from various officials.
Preparing special plans for the administration.

It is hoped that the additional draughtsman who has recently joined will afford some relief, but the work to be done by this office necessitates the provision of a third man to avoid undue delay.

Computing Office.—This office was started during the year, and at present consists of one chief computer. Experience has shown the necessity of this office, numerous mistakes having been found already in the calculations of the surveyors. The addition of a second computer to this office is required at once, and later there will be sufficient work for a third.

(*d*) *Special Work.*—(i) Captain Williams, R.E. was detailed to accompany the Commissioner of Public Works on a trip up the Juba River, which forms the boundary between the British and Italian Protectorates. Captain Williams spent about a month on the river, which he ascended about 250 miles, and, in addition to carrying out his other duties, made the best sketch of the river yet produced. The method adopted was "time and compass" traverses checked nightly by stellar latitudes (the river flows roughly north and south), and by some longitudes obtained by wireless telegraphy through the courtesy of the Italian authorities.

(ii) Funds were provided to enable special survey work in the coast belt to be commenced in September last, for the purpose of registering titles to land. In point of fact the survey was begun earlier by the normal staff of the Cadastral Branch. Although the purpose for which the survey is required is a special one, the actual work differs in no respect from the usual cadastral surveys carried out as a matter of course by the Department. However, the work at present being at the coast, where the land is mostly covered by dense bush, the cost of survey is high, the progress slow, and much fever has been incurred by the surveyors—one of whom unfortunately died in consequence.

(iii) Several final surveys for new roads were carried out by cadastral surveyors. The principal roads were in Nairobi and were laid out with a ruling gradient of 5 per cent.

(*e*) *Map Production.*—The following maps have been published during the year under review :—

Scale $\frac{1}{62500}$ sheet $\frac{South\ A.\ 37}{W.\ I.\ N.\ W.}$ Malindi.

Scale $\frac{1}{125000}$ sheet $\frac{South\ A.\ 37}{V.\ II}$ Mangea.

Scale $\frac{1}{125000}$ sheet $\frac{South\ A.\ 37}{V.\ IV}$ Takaungu.

(*f*) *Expenditure.*—

	Estimated. £	Expended. £
Personal emoluments	11,774	10,296
Other charges	10,856	10,373
Total	22,630	20,669

(*g*) *Revenue.*—

	£
Survey fees	4,360
Sale of departmental plans, &c.	109
Sale of maps	6
Total	4,475

(*h*) *General.*—Major G. E. Smith, C.M.G., R.E., having completed his tenure of office, has returned to England. The Survey Department has, under his directorship, done very good work and produced maps of lasting value.

THE GAMBIA.

Governor ... ... Sir GEORGE DENTON, K.C.M.G.

Survey of Bathurst.—On the application of the Governor the matter of a cadastral surveyof Bathurst was referred to the Colonial Survey Committee.

The object of the survey was to prepare a series of large scale cadastral plans covering the town and immediate neighbourhood, to serve as a property map, and to facilitate engineering schemes.

It was decided that a party should be sent out to execute the survey, that the scale to be adopted should be $\frac{1}{1080}$, and that the work should be published in eight sheets. The party, consisting of Captain B. H. O. Armstrong, R.E., and three N.C.Os., R.E., proceeded to Bathurst and commenced work in November, 1910. Captain Armstrong remained in Bathurst for about a month to start the work, and then returned to England, leaving Sergt. W. F. Crook, R.E., the senior N.C.O., in charge.

The work, which is being carried out sheet by sheet, is estimated to cost £2,000, and should be completed before the end of 1911.

It is regretted that it is necessary to record the deaths, at Bathurst in May, 1911, of the two junior N.C.Os. employed on the work, Lce. Corpl. Page and Lce. Corpl. Muse.

THE GOLD COAST.

Governor ... ... Mr. J. J. THORBURN, C.M.G.
Director of Surveys ... ... Captain E. F. W. LEES, R.E.
Assistant Director of Surveys... Lieut. H A. L. HALL, R.E.
" " " " ... Lieut. P. J. MACKESY, R.E.

(i.) STAFF.

Director of Surveys. | 1 Clerk.

Concession Surveys.

Assistant Director of Surveys. | 5 European Surveyors, R.E.
Chief Surveyor. | 3 Native Surveyors.

Wallis Company Surveys.

Assistant Director of Surveys. | 12 European Surveyors, R.E.

Water Supply and Drainage Schemes.

4 European Surveyors, R.E.

Drawing Office.

3 European Draughtsmen. | 1 Native Draughtsman.

Owing to the leave arrangements (for every 12 months spent in the Colony five months leave, including the voyages home and out) the sections are never at full strength.

The health of the staff was not good; two surveyors were invalided, and the men employed on work in connection with town surveys and drainage and water supply schemes were frequently on the sick list.

(ii) THE WORK OF THE PAST YEAR.

(*a*) *Trigonometrical work.*—None was executed.

(*b*) *Topographical work.*—None was executed. Arrangements have been made for the execution of a topographical survey in the Northern Territories. It is expected that this work will be commenced towards the end of 1911.

(*c*) *Cadastral work.*—The cadastral work undertaken during the year may be considered under the following four headings:—

(i.) Town Surveys.
(ii.) Concession Surveys.
(iii.) The Wallis Company Surveys.
(iv.) Water Supply and Drainage Schemes Surveys.
(v.) General.

(i.) *Town Surveys.*

Accra and Seccondee.—All work in connection with these places was handed over to the staff for water supply and drainage schemes, but it was found possible during the wet season to supplement the staff in Seccondee with members of the concessions surveys staff.

Coomassie.—Fifteen of the sheets of this town survey, on a scale of $\frac{1}{2\,5\,3\,6}$ have been completed, with the exception of certain lines of levels. These sheets contain the whole of the Zongo, native town, European quarters, and the lines.

(ii.) *Concession Surveys.*

The four concession surveys, which were in hand at the commencement of the year, were completed and drawn.

Thirty-four new surveys were commenced during the year, and of these, six are in hand, 28 are completed in the field, and 11 are drawn.

The area of the concessions surveyed is somewhat over 70,200 acres.

(iii.) *The Wallis Company Surveys.*

In September the question of the surveys of the large number of concessions on both sides of the Prah, north of the sixth parallel, was raised, and arrangements were made with the War Office for

a special party consisting of one officer, one draughtsman, and 12 surveyors to be lent for this work. The War Office consented on the condition that a portion of the party was employed on making maps of military value of Ashanti and the Northern Territories. The party arrived in the Colony on the 23rd February, 1911, and proceeded up-country immediately on landing. Various fixed points on the Prah had been laid down in readiness for their arrival, and by the end of March one concession had been completed, and two others were well in hand. This may be considered a satisfactory commencement, as the men employed had had no previous experience in cutting boundary lines in heavy forest.

(iv.) *Water Supply and Drainage Schemes.*

Arrangements were made in the spring for these surveys to be under the supervision of the Director of Surveys, and four surveyors and one draughtsman arrived in the Colony on the 4th May.

Accra.—An attempt was made immediately on the arrival of the surveyors, to demarcate and contour the site of the reservoir; but the work had to be abandoned owing to the rains, and the town survey was taken in hand. The suburbs, Christiansborg and Victoriaborg, were completed, bench marks were laid down throughout the town, and the survey was extended in a westerly direction. All the sheets are now completed, with the exception of one sheet (railway bungalows) which is now in the office. The country west of the Korley Gono Lagoon has been surveyed and contoured, but the plans are not yet complete.

Seccondee.—A serious delay was caused by an outbreak of yellow fever in May, which necessitated the employment of the Royal Engineers on sanitary work. The survey of this town has, however, been successfully completed, and is contained in 11 sheets, on a scale of $\frac{1}{1250}$, but an early revision of these sheets is necessary, owing to the rapid changes which are taking place. All the necessary levels for both drainage and water supply schemes have been taken. In January two surveyors proceeded to the site of the overflow, and, though hampered by illness, completed the necessary work before the end of March. It is hoped that, with three months' work next dry season, all necessary work in connection with the Seccondee water supply schemes will be completed.

(v.) *General.*

As in former years, great difficulty was experienced in obtaining satisfactory labour, the natives preferring to work on the mines, where the work was less arduous. This difficulty was most marked in connection with the town surveys, on which Europeans had to do the work of common labourers themselves, and consequently suffered in health. A serious outbreak of small-pox amongst the carriers caused still further difficulties.

(*d*) *Special work.*—In the spring the Director of Surveys was instructed to proceed to Seccondee with the senior sanitary officer, and draw up a report on the improvements required in that town. A number of plans were drawn, showing drainage proposals, various improvements, the shifting of the native town, the new Zongo,

proposed sanitary railway, &c., and estimates of the total cost, including compensation and acquisition of land, were prepared, the work taking some two months, and the final estimate amounting to £52,000.

During the summer a scheme for the surface drainage of Accra was drawn up by the Director of Surveys, in consultation with the sanitary engineer, and the necessary plans prepared; the scheme is now at home in the hands of the consulting engineers.

During the autumn further work was done at Mangoase in connection with defining the European reservation, &c., and certain lands between Nswam and Mangoase were surveyed.

Throughout the year various plans, &c., for sanitary improvements were prepared.

(*e*) *Map production.*—The proposal to produce a map of the Tarquah (Mining) District on a scale of $\frac{1}{5000}$ was not proceeded with, in view of the large number of new concessions which were taken up in the district during the year. Most of the concessions have now been dealt with, and it may be possible to produce this map during the current year.

(*f*) *Expenditure.*—

	£	*s.*	*d.*
Personal Emoluments	3,020	8	3
Stores	175	0	0
Stationery	22	10	0
Tent Allowances	68	5	6
Horse and Bicycle Allowances	87	0	0
Passages to and from the Colony	180	0	0
Passages Coastwise	37	10	0
Railway Fares and Freight	130	0	0
Freight Coastwise	5	0	0
Carriers	2,172	5	0
Contingent Expenses	5	0	0
Special Expenditure on Concession Surveys	1,758	19	6
Total	7,661	18	3

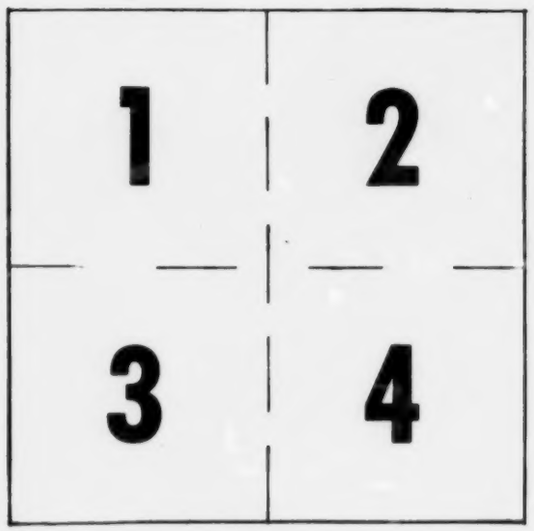
The expenditure on water supply and drainage schemes surveys amounted to £1,935, and was paid on water supply vote.

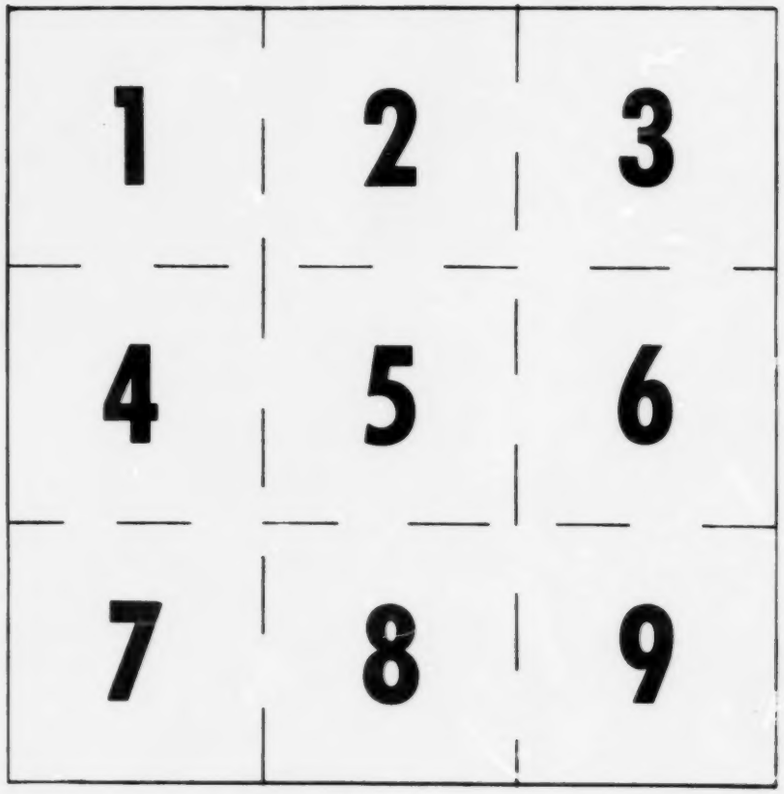
The Assistant Director of Surveys in charge of Wallis Syndicate surveys and his party were paid under "Deposits Repaid—Wallis Syndicate."

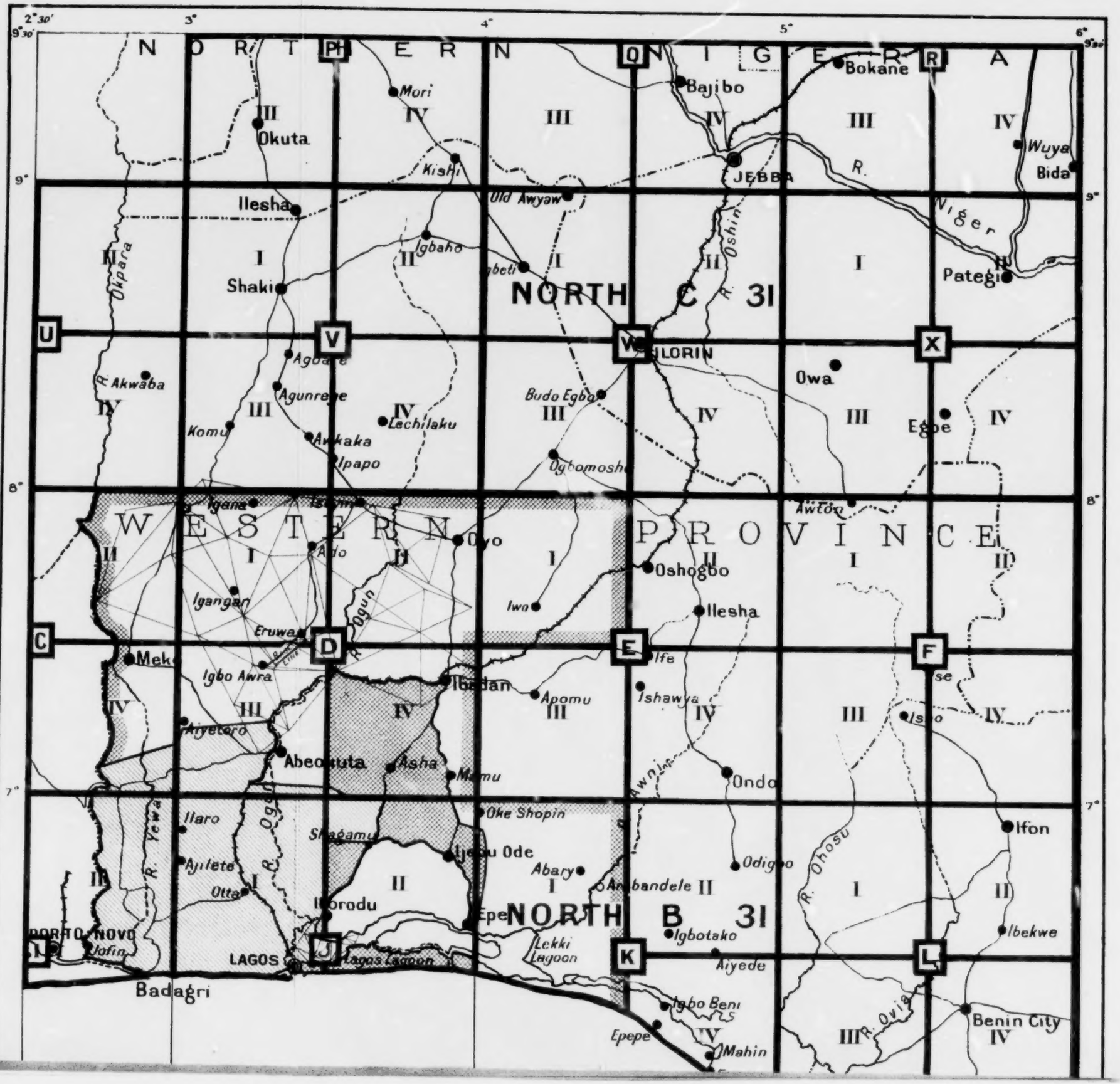
Ashanti.

A draughtsman was obtained for the office of the Intelligence Officer during the year, and a little progress has been made with the map of Northern Ashanti. The many and varied duties of the Intelligence officer preclude his devoting much time to the production of this map.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.






NORTHERN NIGERIA
WESTERN PROVINCE
NORTH C 31
NORTH B 31
Bajibo
Bokane
Mori
Okuta
Kishi
JEBBA
Wuya
Bida
Ilesha
Old Awyaw
Igbaho
Shaki
Pategi
Niger R.
Oshin R.
Okpara R.
Akwaba R.
Agbaye
Agunrege
Komu
Awkaka
Lechilaku
Ipapo
Budo Egba
Ogbomosho
ILORIN
Owa
Egbe
Awton
Igana
Iseyin
Oyo
Ado
Igangan
Iwo
Oshogbo
Ilesha
Eruwa
Ogun R.
Mek
Igbo Awra
Ibadan
Apomu
Ife
Ishawya
Ise
Aiyetoro
Abeokuta
Asha
Mamu
Ondo
Awuna
Oke Shopin
Ilaro
Shagamu
Ijebu Ode
Ayilete
Otta
Abary
Odigbo
Ifon
Ogun R.
Yewa R.
Ohosu R.
Ibadandele
Ijebu Igbo
Ibekwe
PORTO-NOVO
Jofin
LAGOS
Lagos Lagoon
Lekki Lagoon
Igbotako
Aiyede
Igbo Beni
Epepe
Mahin
Ovia R.
Benin City
Badagri
2°30'
3°
4°
5°
6°
9°30'
9°
8°
7°
C
D
E
F
J
K
L
U
V
W
X

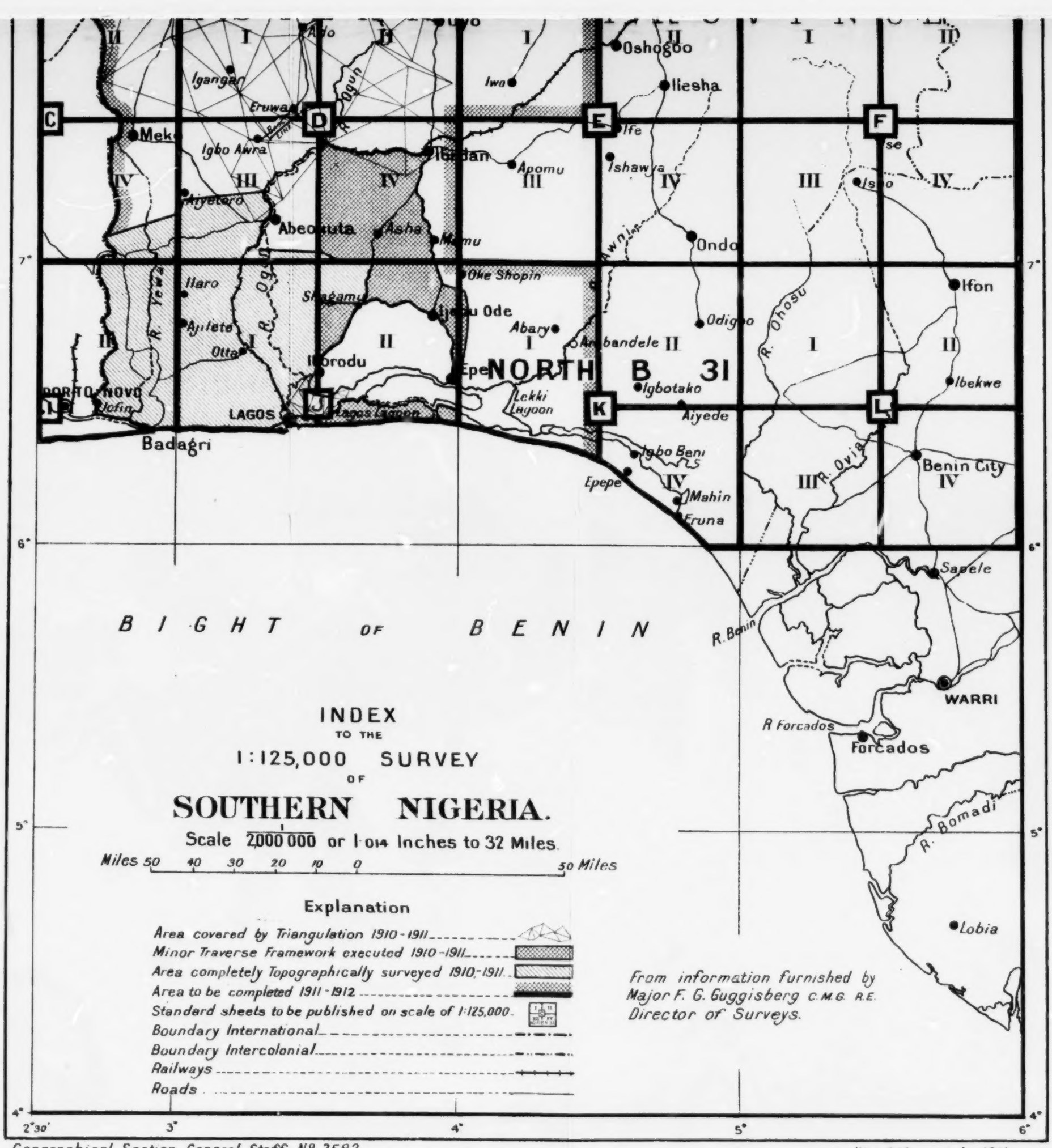
INDEX
TO THE
1:125,000 SURVEY
OF
SOUTHERN NIGERIA.

Scale 1/2,000,000 or 1·014 Inches to 32 Miles.

Miles 50 40 30 20 10 0 50 Miles

Explanation

- Area covered by Triangulation 1910-1911
- Minor Traverse Framework executed 1910-1911
- Area completely Topographically surveyed 1910-1911
- Area to be completed 1911-1912
- Standard sheets to be published on scale of 1:125,000
- Boundary International
- Boundary Intercolonial
- Railways
- Roads



From information furnished by
Major F. G. Guggisberg C.M.G. R.E.
Director of Surveys.

Geographical Section, General Staff No 2583.

War Office July 1911.

NORTHERN NIGERIA.

Governor	...	Sir H. Hesketh Bell, K.C.M.G.
Intelligence Officer	...	Captain H. N. Kempthorne, R.Sc.Fus.

A survey of the Bauchi Tin Mines was commenced during the year, two N.C.Os., R.E., having been sent out to assist Captain Kempthorne. One sheet on a scale of $\frac{1}{2500}$ has been completed, and is now being printed.

The compilation of the map of the Protectorate on a scale of $\frac{1}{250000}$ has been completed. This series, which consists of 64 sheets, was compiled by Captain Kempthorne almost single-handed, and this officer deserves great credit for the work, which was of considerable magnitude. Fifty-three of the sheets have been already published and the remainder will be completed shortly.

SOUTHERN NIGERIA.

Governor	...	Sir Walter Egerton, K.C.M.G.
Director of Surveys ...	...	Major F. G. Guggisberg, C.M.G., R.E.
Intelligence Officer ...	...	Captain W. H. Beverley, Essex R.

(i.) Staff.

Headquarters.

Director of Surveys.
Chief Assistant.
5 Clerks.
2 Photographers.

Cadastral.

Deputy Director of Surveys.
2 European Surveyors.
5 Native Surveyors.
4 „ Draughtsmen.
1 Clerk.

Topographical Branch.

4 Assistant Directors.
9 European Surveyors.
1 „ Draughtsman.
12 Native Surveyors.
5 „ Draughtsmen.

School and Meteorological.

2 Chief Instructors.
Meteorological Clerk.

(ii.) The Work of the Past Year.*

(*a*) *Reorganisation.*—The reorganisation of the Survey Department was taken in hand on April 1st, 1910, and took effect from the 20th June. Owing, however, to the many changes in the staff due to resignations and dismissals, and to the necessity of making provision for the leave of several surveyors, the new

* A full report of the year's work is under publication.

organisation did not take full effect until towards the end of the year.

In organising the new Southern Nigeria Survey, four main objects were kept in view, viz.:—

(i.) *Topographical.*—To produce as rapidly as possible the Standard Map of the Colony on a scale of $\frac{1}{125000}$, and, on its completion, to undertake revision surveys to keep pace with the rapid development of the Colony; to make special surveys required by the Government; and to compile smaller scale Provincial, District, and School Maps.

(ii.) *Cadastral.*—To supply the Government with township, water supply, and other plans that may be required; and to undertake paying work, such as delimiting forest reserves, and private, timber, and agricultural lands.

(iii.) *Educational.*—To train young natives as professional surveyors.

(iv.) *Meteorological.*—To supply instruments for measuring the temperature and rainfall throughout the Colony, and to collect and publish the records.

Field and Recess Seasons.—The European members of the Topographical Branch embark at Lagos on or about June 1st, and return from Liverpool on or about September 15th. This period is the Recess Season, six weeks of which are devoted to leave and the balance to office work. The remainder of the year comprises the Field Season.

The leave of the Cadastral Branch is not restricted to seasons. The Europeans are on the coast for one year, after which they are absent for about five months.

System of Administration.—The survey is governed by the "Survey Hand Book," published in July, 1910, and by circulars which are issued periodically.

Subdivision of Staff.—The staff of the Department is divided into four branches, viz.:—Head-Quarters, Topographical, Cadastral, and School and Meteorological (combined). The Topographical Branch is responsible for the triangulation and theodolite traverses, in addition to its other obvious duties.

(*b*) *Nature of Country and System of Survey adopted.—Nature of Country.*—Southern Nigeria has an area of 77,260 square miles, and, topographically speaking, consists of three main zones:—

(i.) The swamp and mangrove forest zone with undergrowth, which borders the coast and is from 10 to 60 miles in width;

(ii.) the dense forest zone with thick undergrowth, from 50 to 100 miles in width; and

(iii.) the open country zone, chiefly park-like and grass-covered country with forest-clad hills.

Framework.—The horizontal framework of the Topographical Survey in the mangrove and forest zones is constructed by theodolite traverses checked by closing and by observed latitudes and telegraph longitudes, a limiting error of $\frac{1}{3000}$ being aimed at.

The vertical framework in the same zones is constructed by lines of precise levelling checked by closing.

In the inland zone the framework is supplied by main and minor triangulation, supplemented by plane table triangulation with telescopic alidade.

Topography.—In the mangrove and forest zones the topography is sketched by means of compass traverses and aneroid heights. The plane table is used as a portable table, and the survey is plotted during the traverse.

In the open country zone the topography is sketched by plane table and clinometer when possible, otherwise by compass traverses and aneroid.

General.—In all cases the object of the various systems is to ensure accuracy and localise errors by means of a sound framework, and to effect economy by filling in the topography by as rapid a method as possible.

Field Scales:—

For plane table work ... ... $\frac{1}{62500}$.
For compass work ... ... $\frac{1}{12500}$.

(*c*) *Base Measurement.*—A base 9·83 miles in length was measured between Eruwa and Igbo-Awra with an invar apparatus (catenary method) in 24 days, the probable error being extremely small.

(*d*) *Triangulation.*—Observations were taken from 31 main stations, 22 minor stations, and 7 auxiliary stations, and 26 intersected points were fixed; the total area covered by this triangulation being 4,640 square miles at a cost, including reconnaissance and beaconing, of 9*s.* 10*d.* per square mile. The average error in the main triangles was 5·9 seconds (permissible 6 seconds), and in the minor triangles 11·5 seconds (permissible 15 seconds). The trigometrical signals were in most cases heliographs and heliostats.

The actual observations were completed single-handed by Lieut. G. G. Waterhouse, R.E., in about three months.

In addition to the above work, 17 points were beaconed for the work of next season, and points selected by a plane table reconnaissance covering 934 square miles.

(*e*) *Topography and Theodolite Traverses.*—Four $\frac{1}{2}°$ sheets were commenced, of which two were completed in the field, the total area topographically surveyed being 2,579 square miles. The rate of progress was necessarily slow, owing to absence of framework in the initial stages, to the inexperience of the staff, to re-organisation, to the amount of detail in the sheets undertaken, and to the absence of facilities for plane table work.

Theodolite traverses were carried over 237 miles, compass traverses over 4,978 miles, and instrumental liners over 241 miles.

(*f*) *Cadastral.*—The work generally of the Cadastral Branch made slow progress owing to inadequate staff, resignations, and leave in England. Work was carried out in Lagos and Calabar. This Branch is now under re-organisation.

(*g*) *Survey School.*—Very little theoretical instruction was given, as the majority of the pupils were attached to the Topographical Branch for practical instruction.

(*h*) *Map Production.*—*Topographical.*—Nil. *Cadastral*—A revised plan of Lagos Town.

(*i*) *Expenditure.*—The total cost of the Department for the year under review was about £13,904, of which £9,310 was spent on the topographical survey. The cost per square mile of forest country survey was £1 12*s.* 8*d.*

(*j*) *General Remarks.*—The systematic reorganisation of the Survey Department is proceeding on thoroughly efficient lines, and gives promise of the complete, accurate, and economical survey of this important colony. The work is all the more interesting in that it is the first attempt at a scientifically conducted topographical survey, complete in all respects, which has yet been made in British West Africa. Some of the sheets of the survey are now in course of reproduction, and these show with great clearness the value of a deliberate and properly organised topographical survey. The system introduced by the present Director of Surveys has the entire approval of the Committee.

NYASALAND.

Governor ... ... Colonel Sir W. H. MANNING, K.C.M.G., C.B.

Director of Public Works ... Mr. T. I. BINNIE.

(The Public Works Department undertakes the surveys.)

THE WORK OF THE PAST YEAR.

(*a*) *General.*—No field work was undertaken during the year, with the exception of surveys in connection with the re-construction of the Zomba-Blantyre road, and other road surveys.

(*b*) *Map production.*—No maps have been published during the year, but a large number of manuscript plans have been drawn, of which the most important are as under:—

Protectorate map showing the tsetse fly area.
" " " " B.S.A. Co.'s mineral rights.
" " " " Elephant Marsh and the Angoniland game reserves.
I.D.W.O. " " " Angoniland game reserve.
" " " " Elephant Marsh reserve.
" " " " Dedza District.
Part of Marimba District showing the tsetse fly areas.

SIERRA LEONE.

Governor ... ... Sir EDWARD MARSH MEREWETHER, K.C.V.O., C.M.G.

No regular survey work has been carried out in the field during the past year.

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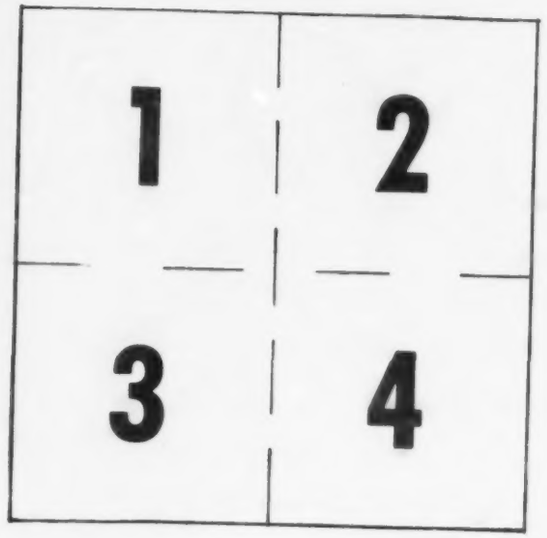

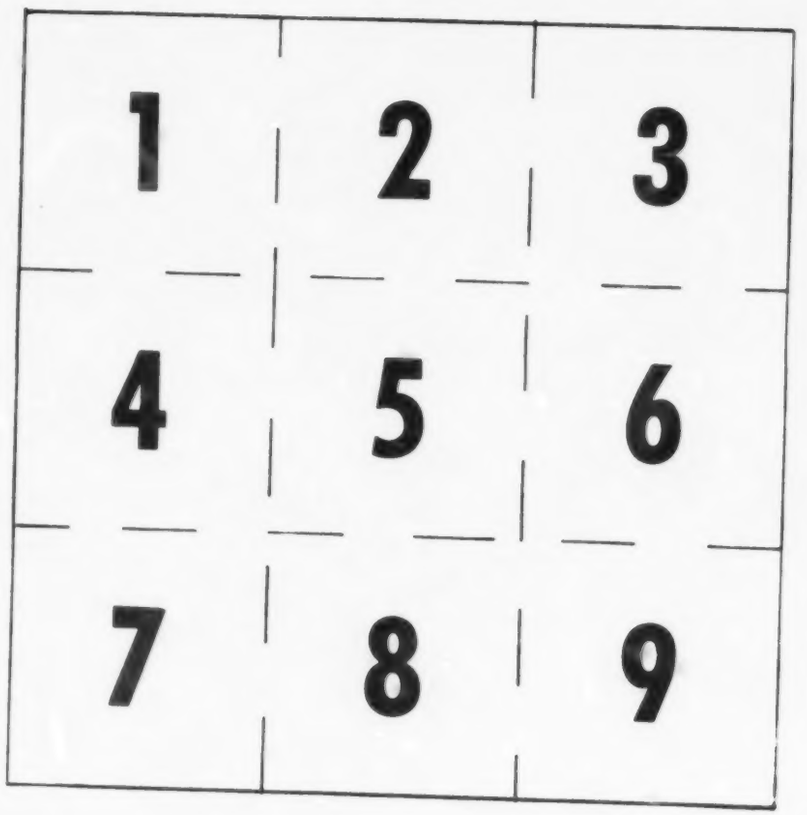

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to the sheets of

SOUTH AFRICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

Miles 50 0 50 100 150 200 Miles

REFERENCE

Work in progress.....
Field sheets completed.....
Sheets published.....
Red names shew names of sheets

The map of the Orange River Colony will be published in district or half district sheets on the 1/125,000 scale

SOUTH-F-35

SOUTH-G-35

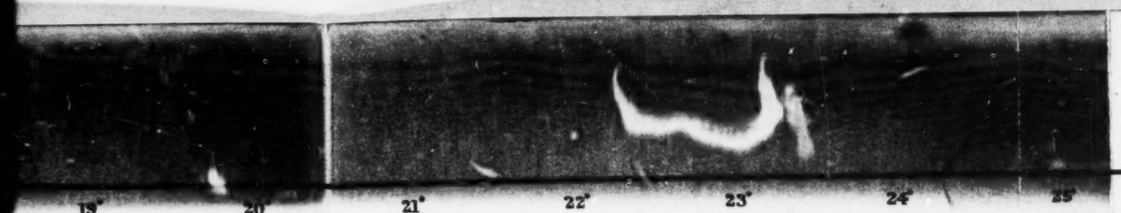
BECHUANALAND

GERMAN SOUTH WEST AFRICA

TRANSVAAL

ORANGE FREE STATE

Tuli
RHODES' DRIFT
ZOUTPANSBE
R. Lotsani
Palapye
MAGALAKWYN
Louis Trichard
N. PONGOLA FLATS
R. Limpopo
R. Pongola
R. Motwani
Mochudi
Gaberones
DERDEPOORT
R. Crocodile
KRANTZBERG
PIETERSBURG
Marabastad
PP. Rust
LEYDSDOR
OHRIGSTAD
GELUK
MYLSTROOM
R. Klipriver
R. Elands
ZEERUST
RUSTENBURG
Pienaars
MAFEKING
PRETORIA
MIDDELBURG
MACHADODORP
Belfast
Krugersdorp
Lichtenburg
MARIBOGO
Geysdorp
JOHANNESBURG
Heidelberg
Bethal
Ermelo
Carolina
PUTCHEFSTROOM
Vereeniging
KLERKSDORP
Vryburg
R. Harts
R. Vaal
R. Klip
AMSTERDAM
LANDERTON
Wolmaransstad
WEDEFORT
Villiers
FRANKFORT
Frankfort
HEILBRON
Taungs
BLOEMHOF
KROONSTAD
Vrede
VREDE
Witkopjes
Wakkerstroom
Volkrust
Standerton
UTRECHT
Vryheid
Hoopstad
HOOPSTAD
LINDLEY
Rietfontein
Bewcastle
Ventersburg
BETHLEHEM
HARRISMITH
Harriamith
Dundee
BOSHOF
WINBURG
SENEKAL
Boshof
Winburg
Bethlehem
Frankfort
FICKSBURG
Fouriesburg
KIMBERLEY
Jacobsdal
LADYBRAND
Ladysmith
KORKESDRIFT
Colenso
Weenen
Greytown
Weston
BLOEMFONTEIN
N.W.
N.E.
WARMBAD
A
SCUIT DRIFT
B
C
UPINGTON
D
E
F
KAKAMAS
GRIQUATOWN
KENHARDT
PELLA
Orange R.
ORANGE RIVER MOUTH
STINKFONTEIN



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to the sheets of

CAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

0 50 100 150 200 Miles

REFERENCE

Work in progress.....

Field sheets completed.....

Sheets published.....

Red names shew names of sheets

The map of the Orange River Colony will be published in district or half district sheets on the $\frac{1}{125,000}$ scale

SOUTH-F-35

SOUTH-F-36

SOUTH-G-35

SOUTH-G-36

TRANSVAAL

ORANGE FREE STATE

BECHUANALAND

SOUTH WEST AFRICA

BASUTOLAND

SWAZILAND

ZULULAND

PORTUGUESE EAST AFRICA

RHODES' DRIFT

ZOUTPANSBERG

PAFURI

LOUIS TRICHARD

LETABA

PIETERSBURG

LEYDSDORP

MARABASTAD

N. PONGOLA FLATS

BLAAUWBERG

MAGALAKWIN

PALAPYE

OHRIGSTAD

GELUK

DERDEPOORT

KRANTZBERG

PYLSTROOM

UMBA

KOMATI POORT

MACHADODORP

MIDDELBURG

RUSTENBURG

PRETORIA

ZEERUST

MAFEKING

LICHTENBURG

KRUGERSDORP

JOHANNESBURG

MARIBOGO

PUTCHEFSTROOM

KLERKSDORP

VRYBURG

WILMARANSSTAD

BLOEMHOF

HOOPSTAD

KROONSTAD

HEILBRON

FRANKFORT

VREDEFORT

VILJOENS DRIFT

VREDE

LINDLEY

UTRECHT

STANDERTON

AMSTERDAM

BREMERSDORP

BETHLEHEM

HARRISMITH

WINBURG

SENEKAL

BOSHOF

FICKSBURG

LADYBRAND

BLOEMFONTEIN

KIMBERLEY

GRIQUATOWN

KAKAMAS

UPINGTON

SCUIT DRIFT

WARMBAD

PELLA

KENHARDT

JACOBSDAL

LADYSMITH

DUNDEE

GLENCOE

DUNDEE

ROBKES DRIFT

ST LUCIA BAY

ENTONJANENI

NDWANDWE

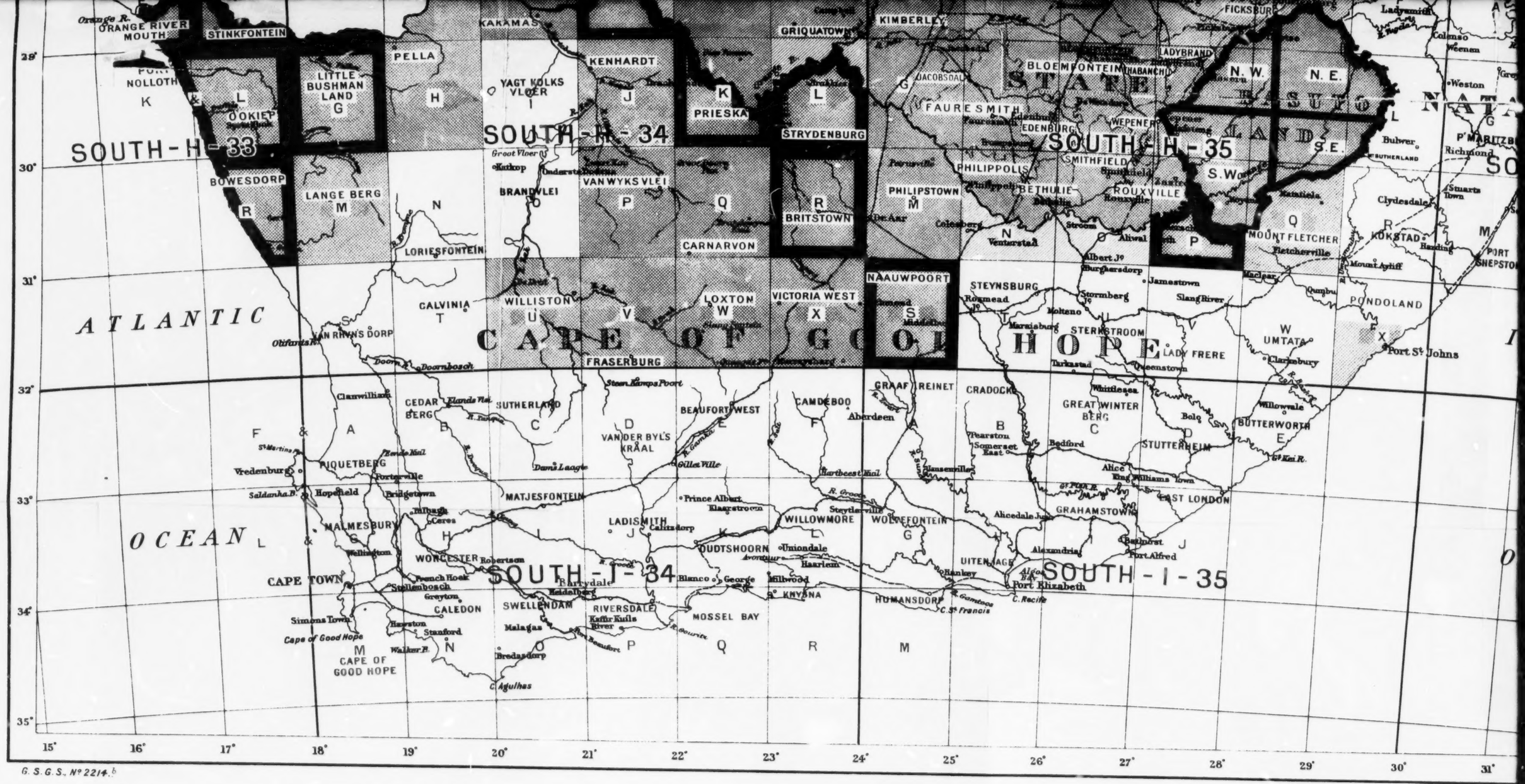
ZULU

USUTU RIVER SOUTH

LAND

N.W.

N.E.


SOUTH-H-33
SOUTH-H-34
SOUTH-H-35
SOUTH-I-34
SOUTH-I-35
CAPE OF GOOD HOPE
ORANGE RIVER MOUTH
STINKFONTEIN
PORT NOLLOTH
OOKIEP
LITTLE BUSHMAN LAND
PELLA
KAKAMAS
YAGT KOLKS VLOER
KENHARDT
PRIESKA
GRIQUATOWN
KIMBERLEY
FICKSBURG
LADYBRAND
BLOEMFONTEIN
JACOBSDAL
FAURESMITH
EDENBURG
WEPENER
N.W.
N.E.
S.W.
S.E.
BOWESDORP
LANGE BERG
BRANDVLEI
VAN WYKS VLEI
STRYDENBURG
BRITSTOWN
PHILIPPOLIS
PHILIPSTOWN
SMITHFIELD
ROUXVILLE
BETHULIE
LORIESFONTEIN
CARNARVON
Groot Vloer R.
Kuikop
Venterstad
Aliwal
MOUNT FLETCHER
Albert Jc
Burghersdorp
Jamestown
KOKSTAD
Clydesdale
Bulwer
Richmond
ATLANTIC
OCEAN
CALVINIA
WILLISTON
LOXTON
VICTORIA WEST
NAAUWPOORT
STEYNSBURG
Rosmead Jc
Molteno
Marsiaburg
STERKSTROOM
LADY FRERE
UMTATA
Clarkebury
PONDOLAND
Port St Johns
VAN RHYN'S DORP
Olifants R.
Doorn R.
Doornbosch
FRASERBURG
Tarkastad
Queenstown
Whittlesea
Willowvale
BUTTERWORTH
Cradock
GREAT WINTER BERG
STUTTERHEIM
Bedford
Somerset East
Pearston
Alice
King Williams Town
EAST LONDON
Gt Kei R.
Gt Fish R.
GRAHAMSTOWN
Alicedale Jc
Bathurst
Port Alfred
Alexandria
Cradock
Graaf Reinet
Aberdeen
CAMDEBOO
BEAUFORT WEST
Steen Kamps Poort
Elands Kal.
SUTHERLAND
CEDAR BERG
Clanwilliam
VANDER BYL'S KRAAL
Dam Laagte
Gilles Ville
Hartbeest Kal.
Blaauwilleberg
Steytlerville
Prince Albert
Elandsgroom
R. Groote
R. Gamka
R. Dwyka
R. Doring
R. Olifants
St Martins
Zwarte Kal.
Vredenburg
PIQUETBERG
Porterville
Saldanha B.
Hopefield
Pridgetown
Hilltagh
Ceres
MATJESFONTEIN
LADISMITH
Calitzdorp
WILLOWMORE
WOLVEFONTEIN
OUDTSHOORN
Uniondale
Avontuur
Haarlem
Blanco
George
Millwood
KNYSNA
HUMANSDORP
C. St Francis
C. Recife
Port Elizabeth
Uitenhage
Hankey
Algoa B.
MALMESBURY
Wellington
WORCESTER
Robertson
CAPE TOWN
French Hoek
Stellenbosch
Greyton
CALEDON
Barrydale
Heidelberg
SWELLENDAM
RIVERSDALE
Kaffir Kuils River
MOSSEL BAY
Malagas
Riet Rivier
Bredasdorp
C. Agulhas
Simons Town
Cape of Good Hope
Hanaton
Stanford
Walker B.
R. Gourits
R. Goukou
R. Groote
R. Gamtoos
Dam Laagte
Beaufort
Tarkastad
Queenstown
Whittlesea
Willowvale
Bolo
Bedford
Somerset East
Pearston
Alice
King Williams Town
Gt Kei R.
Gt Fish R.
Alicedale Jc
Bathurst
Port Alfred
Alexandria
Cradock
Graaf Reinet
Aberdeen
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George
Millwood
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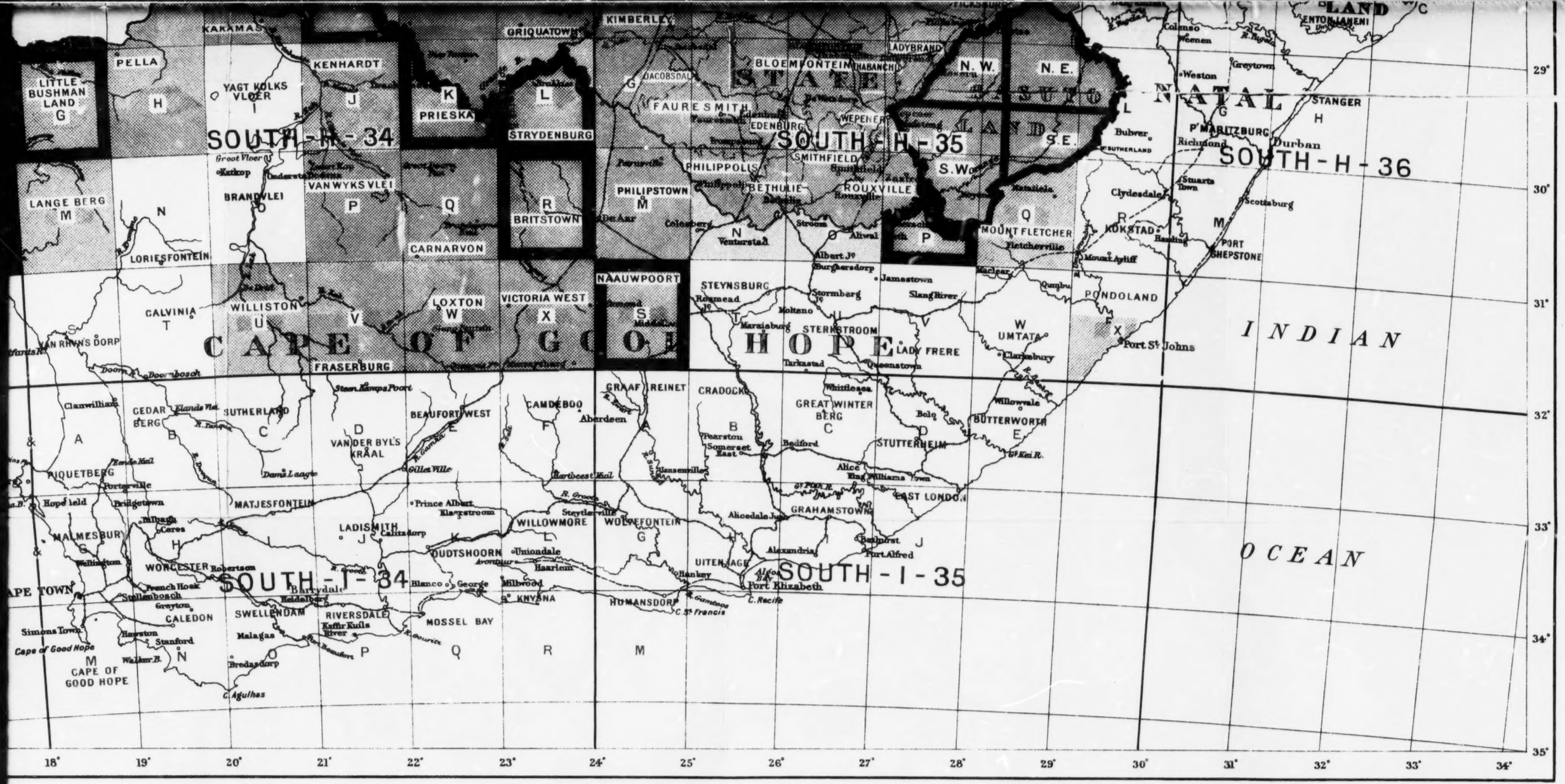
Elandsgroom
R. Groote
R. Gamka
R. Dwyka
R. Doring
R. Olifants
Hartbeest Kal.
Blaauwilleberg
Gilles Ville


SOUTH-H-34
SOUTH-H-35
SOUTH-H-36
SOUTH-I-34
SOUTH-I-35
CAPE OF GOOD HOPE
STATE
N.W.
N.E.
S.W.
S.E.
NATAL
INDIAN OCEAN
KAKAMAS
GRIQUATOWN
KIMBERLEY
LADYBRAND
BLOEMFONTEIN
JACOBSDAL
FAURESMITH
EDENBURG
WEPENER
SMITHFIELD
PHILIPPOLIS
PHILIPSTOWN
BETHULIE
ROUXVILLE
De Aar
Colesberg
Venterstad
Albert Jc
Burghersdorp
Jamestown
Stormberg
Slang River
Molteno
Maraisburg
STERKSTROOM
LADY FRERE
Tarkastad
Queenstown
Whittlesea
Cradock
GREAT WINTER BERG
Bedford
STUTTERHEIM
Alice
King Williams Town
EAST LONDON
GRAHAMSTOWN
Alicedale Junc
Alexandria
Bushmst
Port Alfred
UITENHAGE
Port Elizabeth
C. Recife
HUMANSDORP
C. St Francis
Aberdeen
GRAAF REINET
CAMDEBOO
BEAUFORT WEST
SUTHERLAND
CEDAR BERG
Clanwilliam
VANDER BYL'S KRAAL
Prince Albert
Klaarstroom
Steytlerville
WILLOWMORE
WOLVEFONTEIN
LADISMITH
Calitzdorp
DUDTSHOORN
Uniondale
Avontuur
Haarlem
Barrydale
Blanco
George
Milbrod
KNYSNA
MOSSEL BAY
Kaffir Kuils River
SWELLENDAM
RIVERSDALE
Malagas
Bredasdorp
C. Agulhas
CALEDON
Greyton
Stanford
Hermanus
Walker B.
Caledon
Robertson
WORCESTER
Wellington
French Hoek
Stellenbosch
Simons Town
Cape of Good Hope
MALMESBURY
Ceres
PIQUETBERG
Piketberg
Porterville
Hopefield
MATJESFONTEIN
Dams Laagte
Gilles Ville
Hartbeest Kuil
Steen Kamps Poort
Doorn R.
Doornbosch
FRASERBURG
VAN RHYNS DORP
CALVINIA
LORIESFONTEIN
LANGE BERG
LITTLE BUSHMAN LAND
PELLA
KENHARDT
YAGT KOLKS VLOER
PRIESKA
STRYDENBURG
Groot Vloer
Katkop
BRANDVLEI
VANWYKSVLEI
CARNARVON
BRITSTOWN
NAAUWPOORT
WILLISTON
LOXTON
VICTORIA WEST
Middelpos
STEYNSBURG
Rosmead Jc
Naauwpoort
Hanover Rd
Hanover
Richmond
Middelburg
Cradock
Graaff Reinet
Aberdeen
Somerset East
Cookhouse
Fort Beaufort
Alice
Adelaide
Bedford
Queenstown
Tarkastad
Whittlesea
Molteno
Maraisburg
Sterkstroom
Lady Frere
Cala
Indwe
Dordrecht
Elliot
Barkly East
Rhodes
Matatiele
Kokstad
Mount Ayliff
Mount Frere
Clydesdale
Stuarts Town
Scottsburg
PORT SHEPSTONE
Port St Johns
PONDOLAND
UMTATA
Clarkebury
Willowvale
BUTTERWORTH
Gt Kei R.
Gt Fish R.
Kei R.
Umtata R.
Umzimkulu R.
Umzimvubu R.
Mzimkulu R.
Umkomaas R.
Umgeni R.
Umhlatuzana R.
Umlaas R.
Umsinga
Estcourt
Colenso
Weenen
Ladysmith
Dundee
Greytown
Weston
Bulwer
Richmond
P. MARITZBURG
Durban
STANGER
Umvoti R.
Tugela R.
Buffalo R.
Mooi R.
Bushmans R.
Drakensberg
Basutoland
Orange R.
Caledon R.
Vaal R.
Riet R.
Modder R.
Zand R.
Klip R.
Vet R.
Sand R.
Harts R.
Vaal Kop
Kimberley
Griquatown
Prieska
Strydenburg
Britstown
Carnarvon
Loxton
Victoria West
Williston
Calvinia
Van Rhyns Dorp
Fraserburg
Sutherland
Cedar Berg
Clanwilliam
Piquetberg
Malmesbury
Worcester
Robertson
Caledon
Swellendam
Riversdale
Mossel Bay
George
Knysna
Humansdorp
Port Elizabeth
Uitenhage
Port Alfred
Grahamstown
Alicedale
Cradock
Graaff Reinet
Aberdeen
Camdeboo
Beaufort West
Sutherland
Matjesfontein
Ladismith
Dudtshoorn
Willowmore
Wolvefontein
Steytlerville
Klaarstroom
Prince Albert
Barrydale
Swellendam
Riversdale
Malagas
Bredasdorp
C. Agulhas
Caledon
Greyton
Stanford
Hermanus
Walker B.
Robertson
Worcester
Wellington
French Hoek
Stellenbosch
Simons Town
Cape of Good Hope
Malmesbury
Ceres
Piquetberg
Porterville
Hopefield
Vredenburg
Saldanha
Langebaan
Table Bay
Cape Town
Table Mt
Paarl
Wellington
Tulbagh
Bridgetown
Elands Kal
Elands Vlei
Dams Laagte
Gilles Ville
Hartbeest Kuil
Steen Kamps Poort
Doorn R.
Doornbosch
Fraserburg
Van Rhyns Dorp
Calvinia
Loriesfontein
Lange Berg
Little Bushman Land
Pella
Kenhardt
Yagt Kolks Vloer
Prieska
Strydenburg
Britstown
Carnarvon
Loxton
Victoria West
Williston
Naauwpoort
Middelpos
Steynsburg
Rosmead Jc
Hanover Rd
Hanover
Richmond
Middelburg
Cradock
Graaff Reinet
Aberdeen
Somerset East
Cookhouse
Fort Beaufort
Alice
Adelaide
Bedford
Queenstown
Tarkastad
Whittlesea
Molteno
Maraisburg
Sterkstroom
Lady Frere
Cala
Indwe
Dordrecht
Elliot
Barkly East
Rhodes
Matatiele
Kokstad
Mount Ayliff
Mount Frere
Clydesdale
Stuarts Town
Scottsburg
Port Shepstone
Port St Johns
Pondoland
Umtata
Clarkebury
Willowvale
Butterworth
Gt Kei R.
Gt Fish R.
Kei R.
Umtata R.
Umzimkulu R.
Umzimvubu R.
Mzimkulu R.
Umkomaas R.
Umgeni R.
Umhlatuzana R.
Umlaas R.
Umsinga
Estcourt
Colenso
Weenen
Ladysmith
Dundee
Greytown
Weston
Bulwer
Richmond
P. Maritzburg
Durban
Stanger

A portion of the Karina District has been surveyed by Lieut. E. V. M. Shelley, R. War. Reg., and a portion of the North Sherbro District by Lieut. W. Addison, W.I.R.

Five sheets of the $\frac{1}{250000}$ series of this colony have been revised and published during the past year, and three more sheets will be published shortly.

SOUTH AFRICA.

General State of the Military Surveys.

The topographical surveys of the Cape of Good Hope and Orange Free State Provinces have progressed steadily. The survey of the Orange Free State is now* complete.

A manœuvre area of some 8,500 square miles in the Transvaal has been surveyed.

The total area topographically surveyed in the field during the past six years in the Cape of Good Hope, Orange Free State, Transvaal, and Basutoland, amounts to 170,000 square miles.

BASUTOLAND.

The survey of Basutoland carried out by Captain Dobson, R.F.A. has been reproduced in four sheets, N.W., N.E., S.W., and S.E.

CAPE OF GOOD HOPE.

The Reconnaissance Survey of the northern portion of the Cape of Good Hope was commenced systematically in 1906. In November, 1907, the establishment was fixed at four seconded officers and four attached officers, and it was estimated that the survey would be completed in November, 1911.

In 1909 the area to be surveyed was extended north of the Orange River to the 28th parallel.

The work is based on the geodetic triangulation of South Africa, supplemented by a few lines of minor triangulation, and by graphic triangulation carried out on large plane tables.

The Work of the Past Year.

During the year, an area of 12,630 square miles has been completed in the field. The total area surveyed since the commencement of the reconnaissance survey is 99,922 square miles.

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* July, 1911.

The number of officers working in the field, except during the training season, was eight, of which four were seconded and four attached. The attached officers were absent for two months for training, and two seconded officers were on the sick list for one month.

The seconded officers were :—

Captain R. B. HOPKINS, Manchester Regiment.
„ A. C. L. H. JONES, Northd. Fusiliers.
„ H. R. PAYZANT, Lan. Fusiliers.
„ H. A. P. LITTLEDALE, Yorks. L.I.

The attached officers were :—

Captain J. F. LODER-SYMONDS, South Staffs. Regt.
„ H. S. P. SIMON, Duke of Corn. L.I.
„ H. D. W. LLOYD, Scottish Rifles.
Lieut. J. L. LOCKHART, Hampshire Regt.
„ M. F. DAY, Yorks. L.I.
„ C. H. G. COLLINS, Duke of Corn. L.I.

The number of working days spent on reconnaissance, including marching and minor delays, amounted to 2,220, which gives an output per officer of nearly six square miles per day.

The work was directed by Captain Hopkins, and the four parties were employed chiefly in the north of the Cape of Good Hope to the west and south of Kimberley. This country is undulating and covered with thick bush, which caused much delay to the work, and the parties experienced considerable difficulty in keeping themselves supplied with food and water for both men and animals.

Considering the type of country in which the survey has been carried on, the output of six square miles per day per officer is very satisfactory, and Captain Hopkins and the officers concerned deserve great credit for the progress made during the year.

ORANGE FREE STATE.

(*a*) *The work of the past year.*—During the year under review 12,596 square miles were surveyed in the following districts :—Jacobsdal, Zastron, Smithfield, Phillipstown, Bloemfontein, and Ladybrand.

(*b*) *Conclusion of the Survey.*—Up to May, 1911, 2,274 square miles were completed in the Philippolis district, and the topographical survey of the Orange Free State is now complete.

(*c*) *Origin of the Topographical Survey.*—An arrangement was made between the War Office and the Colonial Government to carry out a topographical survey of the Colony, and to this end the survey section of the Royal Engineers left England in September, 1905, under the command of Captain L. C. Jackson, C.M.G., R.E., assisted by Lieut. A. S. Redman, R.E.

Work was commenced in October, 1905, in the Kroonstad district, and was systematically carried out sheet by sheet.

Captain Jackson and Lieut. Redman completed their tenures of appointment in August, 1908, and the command of the section was taken over by Captain H. St. J. Winterbotham, R.E., assisted by Lieut. A. G. McNeill, R.E.

The field work was completed in May, 1911, and the Colonial Survey Section returned to England.

(*d*) *Methods employed and accuracy.*—The survey is based upon the geodetic triangulation of South Africa.

The geodetic triangulation was broken up into a secondary triangulation, of which the sides varied from 8 to 12 miles in length, and the triangular errors from 3·5 seconds in the earlier years to 2·1 seconds in later years.

In certain parts the secondary triangulation was broken up into a tertiary triangulation with four-mile sides.

The trigonometrical points were plotted on plane tables, and the detail survey was carried out entirely by rigorous plane tabling. The heights depend on the geodetic values.

(*e*) *Rate of progress.*—The rate of progress varied according to the nature of the country, but the average rate maintained was about 21 square miles per diem. The total area of the Orange Free State is about 51,600 square miles.

(*f*) *Scale of the survey.*—The scale adopted for field work was $\frac{1}{126000}$, and the maps are being published on the same scale.

(*g*) *Financial.*—The estimated cost of the survey was £18,500, of which the Colonial Government contributed £9,000, and the remainder was to be chargeable against army votes.

(*h*) *Miscellaneous.*—The topographical survey above described has been excellently carried out, and great credit is due to the officers and men employed on the work. This survey is a happy example of an undertaking carried through as originally planned for the estimated cost.

A considerable amount of work has been done in connection with the reproduction of the sheets of this survey. These sheets will be published as soon as possible.

TRANSVAAL.

The survey of the manœuvre area in the region of Pretoria has been completed. Work was commenced on the 8th February, 1910, and up to the 31st March of that year some 600 square miles had been completed in the field. During the past year the remainder of the area, some 7,900 square miles, have been surveyed. The area includes the most thickly inhabited parts of the Transvaal and the whole of the goldfields, together with the Magaliesberg Zinkerbosh Rand, Losberg and Gatsrand ranges, which accounts for the rate of progress being rather slower than those of the Orange Free State and Cape of Good Hope surveys. However, in spite of the inexperience of the plane-tablers, the daily output per man worked out at five square miles.

The survey party, which consisted of Captain C. St. S. B. Sladen, R.E. in charge, Lieut. K. W. Lee, R.F.A., and four plane-tablers drawn from the two field companies serving in South Africa, has done good work, and has produced a map well suited to the requirements of the case.

UGANDA.

Governor	Mr. F. J. Jackson, C.B., C.M.G.
Director of Surveys	Mr. R. C. Allen.
Officer in charge of the Topographical Survey of Buganda.	Captain W. C. Macfie, R.E.

(i.) Staff.

During the year under review, the staff of the Land and Survey Department was reduced by one European surveyor and increased by two European draughtsmen. At the close of the year the staff consisted of :—

Director of Surveys.	3 Indian Clerks and Draughtsmen.
11 European Surveyors.	1 European Clerk.
1 Indian Surveyor.	
2 European Draughtsmen.	

The work at headquarters was quite sufficient to fully occupy the time of the Director of Surveys and of one assistant. The staff available for field work was, therefore, eight Europeans and one Indian. Two of the European surveyors were allotted to the surveys of townships and Crown lands.

The staff available for cadastral survey was six Europeans and one Indian.

A large amount of leave became due this year. The total amount of leave was 1,517 men days compared with 852 in 1909–1910. This leave was equivalent to a diminution of the staff by four assistants for the whole year and of a fifth for two months.

(ii.) The Work of the Past Year.

(*a*) *Triangulation.*—Nil.

(*b*) *Cadastral.*—The area over which theodolite observations for cadastral work were completed was 509 square miles.

Detail cadastral survey was completed over an area of 509 square miles, and the total area cadastrally surveyed is, therefore, 2,276 square miles.

Taking into consideration the large amount of leave during the year, this progress is by far the best so far obtained. The causes of this result are :—

(i) The improvement in the organization of field work.
(ii) No disturbance of the field parties.

(iii) The continuance of a liberal supply of native labour for cutting boundaries in advance of the surveyors.

(iv) The increased output of the only two surveyors who were continuously employed on field work.

The principal miscellaneous surveys carried out during the year were :—

Marking out the townships of Masindi, Hoima, Butiaba and Fort Portal.

Surveys of plots in Kampala and Jinja.

The demand for surveys of Crown lands to be sold to Europeans has largely exceeded the supply, owing to the absence on leave of the surveyor usually employed on this work.

(*c*) *Expenditure and Revenue.*—The estimated revenue was £4,800 ; the estimated expenditure was £7,058. The actual figures have not yet been determined, but both will probably fall short of the estimates.

The approximate cost of the native estates surveys during this year was £7 15*s.* 4*d.* per square mile.

(*d*) *Land Office.*—The Director, in his report for the year, states that practically no enquiries were received from persons outside Uganda and East Africa, but that locally the demand for land is increasing rapidly.

The number of leases and grants of Crown lands, other than to natives, during the year was 41.

Outside of Buganda, no attempt has been made to define native properties, owing to lack of staff.

The Director reports that it will be necessary to establish a land office at Kampala in the coming year, as the increase of the demands for land in these parts renders it impossible for the Provincial Commissioner to continue to deal with them and also carry out the work of his own office.

Topographical Survey.

The topographical survey of the "kingdom" of Buganda on a scale of $\frac{1}{250000}$ was completed in September, 1910, and the special topographical survey party returned to England. The area surveyed during the year under review was 4,115 square miles, and the total area now surveyed by this party is 13,500 square miles.

The Uganda Topographical Party, under the command of Captain Macfie, did very excellent work, and the result is a striking example of the value of assigning a clear and definite programme of work to a specially selected body of trained topographers. Unfortunately it is necessary to report the death from blackwater fever of Lieutenant H. L. D. Pennington, R.E., who died at Bululu on the 29th July, 1910. The loss of this capable and energetic young officer is very much regretted.

The map of the "kingdom" of Buganda and the surrounding country is in course of reproduction in 9 sheets on a scale of $\frac{1}{250000}$, and should be completed in the autumn of 1911. The material used in the compilation of this map is as under :—

Period.	—	Scale.	Sq. Miles.
1902–4 ...	Anglo-German Boundary Commission (Col. C. Delmé Radcliffe, C.M.G.).	1/100000	600
1904–8 ...	Uganda Survey Department (Mr. R. C. Allen).	1/63360	5,400
		1/125000	
1906–8 ...	Uganda-Congo Boundary Commission (Major R. G. T. Bright, C.M.G., The Rifle Brigade).	1/250000	8,500
1907 ...	Special Survey (Lieutenant C. E. Fishbourne, R.E.).	1/125000	3,400
1907–8 ...	Railway Survey (Captain A. G. Stevenson, R.E.).	—	500
1909–10...	Buganda Topographical Survey (Captain W. C. Macfie, R.E.).	1/250000	13,500
	Total	... ...	31,900

IV.

THE STATE OF THE SURVEYS

OF

BRITISH HONDURAS, CEYLON, CYPRUS, FIJI, JAMAICA, TRINIDAD.

BRITISH HONDURAS.

Governor ... ... Colonel Sir E. J. E. SWAYNE, K.C.M.G., C.B.

Surveyor-General ... ... Mr. H. I. PERKINS, I.S.O., F.R.G.S., F.G.S.

(i.) STAFF OF THE LANDS DEPARTMENT.

Surveyor-General.
Assistant Surveyor-General.
4 Assistant Surveyors.
2 Temporary Surveyors.
2 Forest Officers.
1 Clerk.
1 Draughtsman.

(ii.) THE WORK OF THE PAST YEAR.

(*a*) *Trigonometrical and Topographical*.—No work of this nature has been carried out during the year.

The Legislative Council has approved the commencement of a reconnaissance survey of the Colony, and has voted the sum of $5,000 to meet the expenses of nine months' work. It is intended that one or more skilled topographers, assisted by such local surveyors as can be spared, should start the survey and train the attached surveyors, so that the work may be carried on in future years without special outside assistance. Owing to the climatic

conditions, it is unlikely that the survey can be started before the end of 1911.

(*b*) *Cadastral.*—A total area of 16,000 acres was surveyed in about 251 lots, and 43 miles of traversing were completed for the purpose of linking up surveys, defining boundaries and road making.

(*c*) *Map production.*—A new map of the Colony, chiefly for the use of schools, has been completed and submitted for publication, and 371 tracings were made chiefly for leases and grants, and 17 general plans.

(*d*) *Expenditure* :—

	$
Personal emoluments	15,796
Other charges	8,656
Total	24,452

(*e*) *Revenue* :—

	$
Licenses to cut timber, &c.	2,342
Rents of Crown lands	5,866
Sale of Crown lands	23,031
Local rents in towns	1,222
Total	32,461

CEYLON.

Governor ... ... Col. Sir H. E. McCallum, G.C.M.G., R.E.

Surveyor General ... ... Mr. R. S. Templeton, A.I.C.E., F.R.G.S.

(i.) Staff.

Field.

8 Superintendents of Surveys.
1 Superintendent of Surveys (Temporary).
10 Assistant Superintendents of Surveys.
18 Assistant Superintendents of Surveys (Temporary).
1 Assistant Astronomer.
31 Grade Surveyors.
234 Supernumerary Surveyors.
2 Instructors of Surveying.

Office.

7 Assistant Superintendents of Surveys (Temporary).
72 Clerks and Draughtsmen.
108 Clerks and Draughtsmen (Temporary).
185 Piece-workers.
15 Volunteers.

(ii.) The Work of the Past Year.

(*a*) *Trigonometrical.*—During the year 637 square miles of tertiary triangulation were completed, and 1,328 square miles of

close topographical triangulations with points about 1½ miles apart. The total number of points established was 207, at a cost of Rs. 34,636 including office work.

(*b*) *Topographical.*—230 square miles on the 2″ = 1 mile scale, and 417 square miles on the 1″ = 1 mile scale were surveyed with the plane table in the North Western Province for gap filling.

(*c*) *Block Surveys.*—During the year under review 65,300 acres were block surveyed, the greater portion of the time of the staff being taken up with settlement surveys. These settlement surveys necessitated the re-survey of some 60,000 acres of the existing block survey, and consisted of isolated surveys distributed over an area of some 455,000 acres.

(*d*) *Levelling.*—158 miles of initial levels were run in duplicate at a cost of Rs. 18,256.

(*e*) *Map Production.*—The under-mentioned maps were published by the Survey Department during the year :—

4-mile Eastern Province Agricultural Map in colour.
12-mile Ceylon (revised) in colour.
16-chain Diyatalawa Map for Chief Staff Officer.
Administration Map of Trincomalee District for Government Agent.
24-mile Railway Map for pocket time-table.
32-mile Ceylon Map for Colonial List.
3 sets of Rainfall Maps for Agricultural Society, in English, Singhalese and Tamil.
Ceylon, showing Police Vidanes Divisions.
Ceylon, showing Forest Reserves.
Captain Schneider's Map of Ceylon (reprint).
8-mile Map of Ceylon without hills.

(*f*) *Expenditure.*—

	Rs.
Personal Emoluments	544,642
Other charges	521,847
Special Expenditure	146,074
Total	1,212,563
Amount allotted	1,337,569

CYPRUS.

High Commissioner	Sir Charles A. King-Harman, K.C.M.G.
Registrar-General	Mr. F. O. J. Ongley.
Chief Surveyor	Mr. G. Douglas.

(i.) Staff.

Survey Staff.

1 Chief Surveyor.	1 Chief Draughtsman.
9 Surveyors.	9 Draughtsmen.

Registration Staff.

2 Chief Clerks.	9 Office Clerks.
4 Field Clerks.	10 Valuers.
3 Student Field Clerks.	14 Writers.

(ii.) THE WORK OF THE PAST YEAR.

(*a*) *Trigonometrical.*—Nil.

(*b*) *Topographical.*—Nil.

(*c*) *Cadastral.*—An area of 58,991 acres was surveyed during the year under review.

The procedure adopted in cadastral work is as follows :—

All work is based on the trigonometrical survey carried out by Captain H. H. Kitchener, R.E., assisted by Lieutenant S. C. N. Grant, R.E., which was completed in 1882.

The trigonometrical points are plotted (by co-ordinates) on a platform table. Straight sheet lines running approximately N. and S. and E. and W. are drawn on the table, sub-dividing the whole area of the island into 50 sheets of 12 miles by 8 or 96 square miles. Each sheet is sub-divided into 64 plans, 1½ by 1 mile or 1½ square miles.

Each plan is sub-divided into six traces of 160 acres each.

The trace is the unit as regards the field surveyor.

Lines between trigonometrical points are designated main lines.

The boundary lines of plans are designated plan lines.

The boundary lines of traces are designated trace lines.

The Chief Surveyor first chains the main lines, and checks against the office plan.

He then lays out on the ground the plan lines and trace lines, having first prepared a field book with measurements taken from the office plan. The crossing angles of plan lines and trace lines, with any convenient main lines, are taken off the office plan with a large protractor, and these angles are laid out on the ground (presumably with a theodolite) so as to indicate the direction of chainage. The chainage of all plan and trace lines is checked by comparison with the office plan. The traces are then distributed amongst the assistant surveyors for the detail survey, who first chain their boundaries and then split up their areas by detail lines.

The Chief Surveyor reports that the procedure now adopted has proved satisfactory in the flat region now being surveyed, and that the same procedure may also be adopted in more hilly regions if the sides of the triangles be reduced to three or four miles.

(*d*) *Registration Branch.*—During the year, the following work was carried out by this branch :—

Holdings recorded 38,782 acres,
Holdings valued 63,055 acres.

(*e*) *Map Production.*—The only method of production at present in use is sun printing. The work of plotting is kept well up to the field work, and, as soon as possible, a complete set of sun-prints is supplied to each village.

(*f*) *Expenditure.*—The expenditure of the Cadastral Branch was £1,985, and of the Registration Branch £1,498.

FIJI.

Governor	Sir HENRY MAY, K.C.M.G.
Officer in Charge of the Trigonometrical Survey.	Mr. G. T. MCCAW.
Assistant	Mr. T. RIMMER.

(*a*) *Trigonometrical.*—The reconnaissance of the S.W. portion of Viti Levu was carried out during the year, thus completing the reconnaissance of the island. Of the points beaconed, 11 were main stations and 17 intersected points; the totals now being 38 main stations, three primary stations of the second order, and 27 intersected points.

The observations at 26 main and three primary points of the second order are complete, as are also the observations to 17 intersected points. The field work west of the 178th meridian (rather more than half the island) is now finished. The greatest obstacles to progress were the persistent cloudiness of the higher hills, and the smoke caused by bush fires.

(*b*) *Base measurement.*—The measurement of a base in the neighbourhood of Lautoka was commenced on the 24th May and completed on the 18th June, at a cost of about £40 per mile, exclusive of instruments and terminals. The probable error of field observation, as derived from the discrepancies of the several sections, is $\frac{1}{16}$ inch; as the whole length is 19,320 feet (3 miles 51 chains), this is equivalent to 1 in 4,000,000. Including the errors arising from uncertainty of the coefficient of error and temperature of tape, and of standardisation, the probable error of the whole base is about 9 inches or 1 in 260,000.

(*c*) *Levelling.*—Observations for determining the approximate mean sea level were made over three months at Lautoka, and a line of levels was run to the S.W. terminal of the base.

(*d*) *Topographical.*—A topographical survey of the forest regions has been commenced. It is impossible to conduct a plane table survey in these regions, owing to the denseness of the forest, and advantage was taken of the clearances made on the hill-tops in connection with the triangulation, to employ the stereo-photographic method of survey. As the work is conducted by the reconnaissance and beaconing party, whose movements are determined by the trigonometrical party, it has not been possible to make a systematic survey of any one tract of country. In all 62 pairs of views were obtained from 18 stations, and plotting has been commenced (with a stereo-plotter) at a scale of $\frac{1}{31680}$ with 100-foot contour interval. The rest of the plotting will probably be done in England.

(*e*) *General.*—The health of the staff and porters has been good. The trigonometrical survey has made very good progress under the direction of Mr. McCaw and of his assistant Mr. Rimmer.

JAMAICA.

Governor ... ... Sir SYDNEY OLIVIER, K.C.M.G.
Surveyor-General ... ... Mr. COLIN LIDDELL.

(i.) STAFF OF CROWN LANDS DEPARTMENT.

Surveyor-General.
2 Assistant Surveyors.
3 Clerks.
1 Typist.
110 Bailiffs and Headmen.

(ii.) THE WORK OF THE PAST YEAR.

(*a*) *General.*—There is no Survey Department, properly so called, in the Island; all necessary surveys executed by the Crown Lands Department, the staff of which given above.

(*b*) *Trigonometrical and Topographical.*—No work of this nature was done during the year.

(*c*) *Cadastral.*—This work includes the surveys of lands forfeited to the Crown for non-payment of taxes, and the delimitation therefrom of tax-paid areas belonging to private owners, and of lands sold or purchased by the Crown. These surveys were all, except in the case of opening boundary lines, closed traverses with closing errors of 1 in 2,666 to 1 in 800, and aggregated 220 miles.

(*d*) *Map production.*—A large number of pentagraph reductions were made in connection with the proposed one inch to the mile map of the island. Numerous plans and tracings were made for the use of departments and to the order of property owners for the purpose of defining boundaries.

(*e*) *Expenditure.*—The total expenditure of the Department during the year was £2,881, of which only £374 was spent on surveys.

TRINIDAD.

Governor ... ... Sir GEORGE R. LE HUNTE, K.C.M.G.
Engineer in charge of Surveys ... Mr. E. R. SMART.

(i.) STAFF.

Engineer in Charge of Surveys.

Crown Lands Branch :
2 Assistants.
4 Draughtsmen.
1 Clerk.

Trigonometrical Branch :
3 Assistants.

(ii.) The Work of the Past Year.

(*a*) *Triangulation.*—During the year 13 new stations were fixed.

(*b*) *Topographical.*—A coastal survey from Maracas Bay to Port of Spain has been made by the Trigonometrical Branch.

(*c*) *Cadastral.*—Surveys have been conducted in the following districts, but no account of the areas has been received :—

Tucker Valley and adjacent estates.
Caroni Savana, Munro Road, and adjoining properties.
Laventille.

The Laventille survey was conducted by the Crown Lands Branch, and the remainder by the Trigonometrical Branch.

(*d*) *Map production.*—No maps have been published, but several are in the hands of the engravers.

(*e*) *Expenditure:*—

	£
Crown Lands Branch—	
Salaries	1,90[illegible]
Travelling	213
Surveys	3,381
Office	17
	5,511
Trigonometrical Branch	2,163
Total	£7,674

(8) 2019

V.

TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
1	Gambia (Anglo-French)	425	Aug. 10th, 1889	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Lecomte, Civil Administrator.	Nov., 1890, to May, 1891	May, 1891	June 9th, 1891.	—	—
1	" "	—	" "	British :— Mr. Reeve. Mr. Ozanne. French :— M. Pargue. Lieut. de Jussien. M. Robert (Interpreter).	1895–8.	—	—	—	—
1	" "	—	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898–9.	—	—	—	—
1	" "	—	April 8th, 1904	British :— Major Cowie, W.I.R. Mr. B. B. de Tscharner.	1905–6.	—	—	—	—
2	Sierra Leone—French Guinea.	260	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Capt. A. H. Kenney, R.E. French :— M. Lamadon, Governor of the French Colony of Les Rivières-du-Sud.	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembi-Kunda.
2	" "	—	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Millot.	Dec., 1895, to May, 1896.	1895, 1896	April 9th and 30th, 1896.	June 14th and 16th, 1898.	From the Coast to Tembi-Kunda.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
2	Sierra Leone—French Guinea.	8	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Mr. Birch. French :— M. Lescure.	1900 and Jan. 15th, 1903.	1903.	Mar. 12th, 1903.	Exchange of notes, Mar. 22nd and April 5th, 1904.	Tembi-Kunda Eastwards.
3	Sierra Leone—Liberia ..	195	Nov. 11th, 1885	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E. Liberian :— Mr. J. McCarthy.	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	Jan. 21st, 1911.	—
4	Gold Coast—Ivory Coast (Anglo-French).	450	July 12th, 1893	British :— Major A. E. G. Watherston, R.E. Capt. Soden, R. Fus. Capt. H. B. Des Voeux, R.E. French — M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903.	Feb. 1st, 1903.	May 11th and 15th, 1905.	—
5	Gold Coast, Northern Territories — French Sudan, Senegambia-Niger (Anglo-French Boundary North of Gold Coast).	195	Convention, June 14th, 1898.	British :— Major A. E. G. Watherston, R.E. Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	—	Aug. 16th, 1901.	—	—
5	" "	"	Agreement, Mar. 18th/ April 25th, 1904.	British :— Capt. J. O'Kinealy. French :— Lieut. F. Verlaque.	—	1904.	Oct. 19th, 1904.	May 24th/ July 19th, 1906.	—
6	Gold Coast, Northern Territories — Togo (Anglo-German).	165	Convention, Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E. Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried.	Dec., 1901, to Sept., 1902.	—	July 21st, 1902.	—	—

6	"	"	"	"	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.		—	Sept., 1904, to Dec., 15th, 1905.	—	June 25th, 1904.	North of 9th parallel only.	—
7	Gold Coast — Togoland (Anglo-German).	125	Convention, July 1st, 1890.	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	1904.	Oct. 11th, 1904.	—	In one exchange of notes.	From 9° N. Lat. to Niger.	From the Coast to 9° N. Lat. Treaty Series No. 15, 1899.
8	Lagos—Dahomey (Anglo-French).	235	June 14th, 1898	British :— Major J. I. Lang, C.M.G., R.E. French :— Commdt. Touteé.	1900.	—	Dec. 22nd, 1900, and Jan., 1905.	Oct. 19th, 1906.				
9	" " ..	200	August 10th, 1889, July 12th, 1893.	British :— Mr. F. C. Fuller. Mr. A. G. Fowler. Dr. Hay. French :— Capt. J. Plé. Lieut. Brisson.	1895–6.	—	Oct. 12th, 1896, Art. II. June 14th, 1898.	Oct. 19th, 1906.				
9	" ..			British :— Capt. Anderson. French :— M. Perreur.	1900.	—	—	—				
10	Niger—Chad (Anglo-French).	860	June 14th, 1898, April 8th, 1904.	British :— Lieut.-Col. G. S. McD. Elliott, R.E. Capt. C. H. Foulkes, R.E. Capt. G. E. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty. Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906, May 29th, 1906.	—				
10	" " ..	"	May 29th, 1906	British :— Major R. P. O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Audoin. Lieut. Vignon.	1906, 1907.	1907, 1908.	Feb. 25th, 1908.	—				

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	REMARKS.
11	Yola—Chad (Anglo-German).	350	Convention, Nov. 15th, 1893 Preliminary Agreement, Dec. 2nd, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E. Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B. Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Aug. 10th, 1903, Feb., 1903, to Feb., 1904 and 1905.	—	Feb. 24th, 1904, and Mar. 19th, 1906.	July 16th, 1906.	(Treaty Series, No. 17, 1906.)
11	" "	40	" "	Local Commission to mark Boundary :— British :— Mr. Hans Fischer. German :— Leut. von Stephani.	—	1906 to 1907.	Feb. 12th, 1907.	Mar. 5th, 1909.	From Gorege to Lake Chad. (Treaty Series, No. 17, 1909.)
11	" "	81	" "	British :— Capt. Vicars Boyle. German :— Capt. von Stephani.	—	1907.	Mar. 11th, 1907.	Mar. 5th, 1909.	From Uba, on Yedseram River, to River Benue.
12	Cross River (Southern Nigeria—Kameruns).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug. 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th, 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1895.	—	—	—	Cross River to the Sea.
12	" "	"	" "	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	—

13	Cross River Rapids—Yola Arc.	285	Nov. 15th, 1893	British :— Lieut-Col. G. F. A. Whitlock, R.E. Capt. H. T. G. Moore, R.E. Lieut. W. V. Nugent, R.A. 2nd Lieut. W. D. Downes, Royal Sussex Regiment. German :— Major Haering. Oblt. von Stephani. Oblt. Cuno. Oblt. Rothe.	Aug., 1907, to May, 1909.	—	April 16th, 1909.	—	—
14	Barotseland—Angola ..	710	Convention, July 11th, 1891, and Arbitration award, May 30th, 1905.	—	—	—	—	—	Not yet delimited.
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	—	—	—	—	—	Not yet delimited.
16	Bechuanaland—German South-West Africa.	1113	July 1st, 1890, Art. III. (A.G.), Dec. 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British :— Major H. D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1898 to 1903.	—	—	Part only of boundary delimited.
16	Cape Colony—German South-West Africa (Orange River).		July 1st., 1890, Art. III.	—	—	—	—	—	Not yet delimited.
17	Amatongaland—Portuguese East Africa.	30	June 11th, 1891, Art. III.	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	Aug., 1896, to Dec., 1896.	—	—	—	—
17	" "	"	" " "	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	—	Aug. and Oct., 1897.	Oct. 2nd, 1897.	Dec. 29th, 1898/Jan. 25th, 1899.	—
18	Swaziland—Portuguese East Africa.	65	Conference, April to June, 1907.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1888, 1894, and 1897.	April, 1907	—	—	Portuguese and Boer Commission.

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS.
19	Transvaal — Portuguese East Africa.	255	July 29th, 1869. Convention of London, Feb. 27th, 1884.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major A. Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1887, 1890, and 1894.	1887, 1890, 1894.	—	—	Portuguese and Boer Commission.
20	Limpopo River to Sabi River (Anglo - Portuguese).	115	June 11th, 1891	British :— Mr. W. J. Atherstone. Portuguese :— José A. Serrano.	Dec. 1902, to July, 1903.	—	Dec. 21st, 1903/July 19th, 1904.	June 3rd, 1907.	In one exchange of notes.
21	Mazoe or Manica Boundary (Anglo - Portuguese 18° 30′ S. to Sabi River).	235	June 11th, 1891, and Arbitral award, Jan. 30th, 1897.	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	June 3rd, 1907.	In one exchange of notes.
21	" "	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade.	—	1898. 1899.	June 5th and 28th, 1898, and Dec. 14th and 15th, 1898	—	—
22	Barue Boundary (Anglo-Portuguese, River Mazoe, and 18° 30′ South).	145	June 11th, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E. Portuguese :— Capt. Garcia Rosado.	1898.	1905	Dec. 28th, 1898.	Mar. and April, 1902, Jan. and April, 1904.	Exchange of notes.
23	Anglo-Portuguese Boundary South of River Zambesi.	215	" "	British :— Mr. Sawerthal. Portuguese :— Lieut. Durao.	1903–4.	—	—	—	Provisional survey.

23	" "	215	" "	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. S. Gugo Coutinho.	April 1905, to Oct., 1905.	1905.	Oct. 4th, 1905.	—	—
23	" "	47	" "	British :— Mr. E. R. Morkell. Capt. J. Tait, B.S.A. Police. Portuguese :— Luiz Lopes de Conceicas, Junior. Jayme Lino.	—	—	Nov. 13th, 1910.	—	Line from Mount Gungwa to Mount Chera taken over.
24	Anglo-Portuguese Boundary North of Zambesi.	260	June 11th, 1891	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. S. Gugo Coutinho.	June, 1904, to Nov., 1904.	1904.	Nov. 21st, 1904.	—	—
25(*a*)	Nyasaland Protectorate —Portuguese East Africa (Anglo-Portuguese).	660	" "	British :— Mr. J. F. Cunningham. Mr. T. I. Binnie, Surveyor. Portuguese :— Capt. Ferraz. Conde. Du Pont. Capt. Branco.	July to Nov., 1899. Oct. to Dec., 1900.	1899–1900.	Dec. 8th, 1900.	*Sept. 15th, 1906.	Section from River Ruo to Lake Chiuta (Provisional Boundary Commission).
25(*b*)	" "			British :— Mr. A. James Swann. Mr. Thomas I. Binnie, Surveyor.					To make some alterations to previous line. Beaconed from B. P. 38 to Mt. Kapiriuta.
25(*c*)	" "	91	" "	Local Commission :— British :— Mr. A. J. Swann. Mr. T. F. Firr, Surveyor. Portuguese :— 2nd Lieut. Antonio de Brito.	—	1907.	—	—	
25(*d*)	" "	—	June 11th, 1891	Local Commission :— British :— Mr. T. I. Binnie. Portuguese :— Ernesto Tavares D'Almeido Carvalho.	April-May, 1908.	—	May 22nd, 1908.	—	Ruo and Shire Rivers.

* Provisional confirmation of recommendations of Boundary Commissioners, 1899 and 1900 (Procès Verbal, December 8th, 1900).

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS.
26	Nyasa-Tanganyika (Anglo-German).	225	July 1st, 1890	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Boileau, R.E. Capt. Chichester. Lieut. Scratchley. German :— Hptmann Herrmann. Leut. Glauning. Dr. Kohlschütter.	1898.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—
27	Congo Free State—North-West Rhodesia.	1,200	May 12th, 1894	—	—	—	—	—	Not yet delimited.
28	Congo Free State—Uganda and Sudan.	800	May 12th, 1894, and May 9th, 1906.	British :— Lieut.-Col. R. G. T. Bright, C.M.G., Rifle Brigade. Capt. E. M. Jack, R.E. Lieut. Hon. F. R. D. Prittie, Rifle Brigade. Congolese :— Commandant E. Mercier, 2nd Regiment des Guides. Commandant J. Bastien, 2nd Regiment des Grenadiers. Commandant Stockhausen. Lieut. Weber. Lieut. Mauray.	Jan., 1907 to April, 1908.	—	—	—	—
28	" " "	36	—	British :— Major E. M. Jack, R.E. Capt. Hon. F. R. D. Prittie, Rifle Bgde. Congolese :— Capt. Commandant J. Bastien. Capt. Maury. Lieut. Weber. Lieut. Wuidart.	—	1911.	May 4th, 1911.	—	From Mount Sabinio to Mount Nkabwa.
29	British — German East Africa (Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith, R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 25th, 1893.	—	—

29	" " "	1	July 25th, 1893	British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897.	1900.	Jan. 23th, Feb. 14th, and April 25th, 1900.	—	Not beaconed throughout its entire length.
30	British — German East Africa (South end of Jipe to Lake Victoria).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	—
30	German East Africa—Uganda.	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	July, 1902, to Apr. 1904.	1904.	July 18th, 1906.	—	—
30	" " "		—	British :— Major E. M. Jack, R.E. Capt. Hon. F. R. D. Prittie, Rifle Bgde. German :— Hptmann Schlobach. Hptmann Fouck.	—	1911.	—	—	—
31	Italian Somaliland — British East Africa.	375	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
31(*a*)	British Somaliland — Abyssinia.		May 14th, 1897, June 4th, 1897.	—	—	—	—	—	Not yet delimited.
32	British Somaliland — Italian Somaliland.	710	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
33	British Somaliland — French Somali Coast.	50	February 2nd, 1888 ..	—	—	—	—	—	Not yet delimited.
34	Uganda and East Africa —Abyssinia Boundary.	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900-01.	—	—	—	—
34	" " "	"	—	Capt. P. Maud, R.E. Mr. J. Baird.	Oct. 1902, to July, 1903.	—	—	—	—
34	" " "	"	December 6th, 1907 ..	Major C. W. Gwynn, C.M.G., D.S.O., R.E. Capt. R. L. Waller, R.E.	1908. 1909.	1908. 1909.	—	—	—

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS.
35	Sudan—Abyssinia ..	760	Treaty, May 15th, 1902	Major H. H. Austin, R.E. Lieut. C. W. Gwynn, R.E.	—	—	—	—	—
35	" " ..	"	" " "	Brev.-Major C. W. Gwynn, R.E., D.S.O.	1903.	1903.	—	—	—
36	Sudan—Eritrea	330	December 7th, 1898, June 1st, 1899, April 16th, 1901, November 22nd, 1901, May 15th, 1902.	British :— Col. the Hon. M. G. Talbot, R.E. Italian :— Major Martinelli. Tenente. A. Pollera. Capt. Tornare.	1903.	—	—	—	R. Setit to Abu Gamal.
36	" " ..	"	" " "	Brev.-Major W. J. Walter, Lancs. Fus.	1899, 1901.	—	—	—	From Sabderat North - Eastwards.
37	Anglo - French — From Congo-Nile Watershed to Tripoli.	1,950	March 21st, 1899 .. Treaty, Series 15, 1899.	—	—	—	—	—	Not yet delimited.
38	Egypt—Tripoli	1,000	—	—	—	—	—	—	Not yet delimited.
39	Egypt—Turkish, Sinai Peninsula.	140	Firman, 1841	British :— Capt. R. C. Owen. Mr. Wade. Mr. Keeling. Turkish :— Mazzaffer Bey Fehim Bey.	1906.	1906.	—	Oct. 1st, 1906.	—

VI.

CLASSIFIED LIST OF THE STAFFS OF SURVEY DEPARTMENTS.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	EAST AFRICA PROTECTORATE.				
	Superintending Staff.				
Director of Surveys	Capt. G. S. Knox, R.E. ...	800	... ...	... ...	28th Dec., 1910.
Clerk—Storekeeper	Mr. A. Rehm	250	... ...	... ...	4th Jan., 1906.
Typist and Stenographer ...	Mr. E. Rehm	80	... ...	... ...	1st Jan., 1909.
	Trigonometrical and Topographical Branch.				
Deputy Director of Surveys ...	Capt. G. C. Williams, R.E. ...	667	... ...	... ...	28th Dec., 1910.
Assistant " " ...	Lieut. A. M. Coode, R.E. ...	525	... ...	... ...	10th May, 1909.
" " " ...	Vacant	525	... ...	... ...	—
Surveyor	Sergt. J. Healy, R.E.	300	... ...	... ...	10th Dec., 1909.
"	L.-Corpl. H. Thornton, R.E. ...	215	... ...	... ...	15th July, 1908.
"	L.-Corpl. J. P. Durkan, R.E. ...	215	... ...	... ...	15th July, 1908.
"	L.-Corpl. J. Rimmer, R.E. ...	215	... ...	... ...	20th Jan., 1909.
"	L.-Corpl. J. P. Garvey, R.E. ...	215	... ...	... ...	26th May, 1909.
"	L.-Corpl. A. Hursey, R.E. ...	200	... ...	... ...	10th Dec., 1909.
	Cadastral Branch, Deputy Director's Office.				
Deputy Director of Surveys ...	Mr. A. E. Townsend	500	... ...	... ...	28th Dec., 1908.
Assistant " " ...	Mr. T. H. Galbraith	450	... ...	... ...	28th Dec., 1908.
Chief Clerk—Accountant ...	Mr. E. W. Nicholls	160	£40 house allowance	... ...	5th Jan., 1909.
Assistant Accountant... ...	Mr. W. T. West	140	" " "	... ...	4th July, 1908.
" "	Mr. I. Lewison	130	" " "	... ...	1st Feb., 1911.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	Cadastral Branch, Surveyors.				
District Surveyor	Mr. J. T. Stiles...	400	... ...	... ...	28th April, 1908.
" "	Mr. F. H. Jordan	380	... ...	... ...	1st March, 1909.
" "	Mr. G. Woodruff	360	... ...	... ...	1st July, 1910.
Senior Staff Surveyor... ...	Mr. W. M. Nightingale ...	340	... ...	... ...	1st April, 1907.
" " "	Mr. D. G. Crofts	300	... ...	... ...	1st July, 1910.
" " "	Vacant	300	... ...	... ...	—
" " "	Vacant	300	... ...	... ...	—
Junior Staff Surveyor... ...	Mr. J. Marsengo	280	... ...	... ...	1st April, 1907.
" " "	Mr. E. K. Boileau	280	... ...	... ...	10th July, 1908.
" " "	Mr. A. Bessler	280	... ...	... ...	14th Sept., 1908.
" " "	Mr. H. C. Anderson	250	... ...	... ...	1st July, 1910.
" " "	Mr. H. M. Thornhill	250	... ...	... ...	14th June, 1910.
" " "	Mr. R. J. Gouiston	250	... ...	... ...	16th Sept., 1910.
Assist. Junior Staff Surveyor	Mr. C. E. Taylor	120	... ...	... ...	6th Oct., 1909.
" " " "	Vacant	120	... ...	... ...	—
" " " "	Vacant	100	... ...	... ...	—
" " " "	Vacant	100	... ...	... ...	—
Indian Surveyor	Mohamed Din	128	... ...	... ...	4th Aug., 1903.
" "	Abdul Quadir Kan	64	... ...	... ...	27th June, 1907.
" "	Shib Dass	56	... ...	... ...	16th Sept., 1910.
	Computing Office.				
Chief Computer	Mr. J. H. Williams	180	... ...	... ...	1st Aug., 1910.
	Drawing Office.				
Chief Draughtsman	Mr. C. J. B. Panting	250	... ...	... ...	15th Aug., 1906.
Draughtsman	Mr. A. E. Fischer	160	... ...	... ...	1st Aug., 1910.
"	Mr. S. H. Ramsey	160	... ...	... ...	24th Jan., 1911.
Indian Tracer	Aziz Bux	72	... ...	... ...	15th Aug., 1904.

„ „	D. W. Simeon	48	... ...	... ...	1st Feb., 1911.
„ „	H. Singh	44	... ...	... ...	1st Aug., 1908.
„ „	Tajuddin	44	... ...	... ...	1st Aug., 1908.
Indian Photographer	Behari Lal	40	... ...	... ...	1st Aug., 1908.
	Record Room.				
Clerk	Mr. A. J. de Mello	68	... ...	... ...	1st Dec., 1906.
	Mombasa Office.				
Office Assistant	Mr. F. Smythe	190	... ...	... ...	1st April, 1909.
	GOLD COAST.				
Director of Surveys	Capt. E. F. W. Lees, R.E. ...	800	£160 duty allowance, £36 horse allowance.	Temporary	4th Jan., 1908.
Assistant Director of Surveys	Lieut. H. A. Lewis Hall, R.E.	400–20–500	£80 duty allowance £120 commuted allowances.	„	18th May, 1910.
„ „ „ „	Lieut. P. J. Mackesy, R.E. ...	600	Nil	„	8th Feb., 1911.
Chief Surveyor	Mr. G. V. Mathieson	250–10–300	£120 commuted allowances.	Permanent	4th Jan., 1908.
Surveyor	2nd Corpl. R. N. Kilby, R.E....	250–10–300	£120 commuted allowances.	Temporary	4th Jan., 1908.
„	L.-Corpl. A. J. Jones, R.E. ...	250–10–300	£90 commuted allowances.	„	19th June, 1909.
Draughtsman	Sapper A. F. R. Morris, R.E....	250–10–300	Nil	„	6th April, 1910.
Native Surveyor	Mr. J. B. Esuman Gwira ...	200–10–250	4*s.* per diem tent allowance.	Three years probation	1st Jan., 1908.
Assistant Native Surveyor ...	Mr. E. J. Smith	120–5–150	1*s.* per diem tent allowance.	„ „	„ „
„ „ ...	Mr. H. E. Sagoe	120–5–150	1*s.* per diem tent allowance.	„ „	1st May, 1910.
Native Draughtsman	Mr. R. Josiah	120–5–150	Nil	„ „	1st Jan., 1908.
4th Grade Clerk	Mr. A. F. Penson	60–5–80	Nil	Permanent	„ „

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	Concession Surveys.				
Surveyor	Sapper A. Evans, R.E. ...	240	£90 commuted allowances.	Temporary	2nd Feb., 1910.
"	" J. R. A. Miller, R.E....	240	" " "	"	2nd Feb., 1910.
"	" G. F. Spice, R.E. ...	240	" " "	"	14th July, 1910.
	Water Supply and Drainage Schemes.				
Draughtsman	Sapper J. Hague, R.E. ...	250	Nil	Temporary	20th April, 1910.
Surveyor	" G. Walker, R.E. ...	240	£90 commuted allowances.	"	" "
"	" P. Hallahaw, R.E. ...	240	" " "	"	" "
"	" R. N. Corner, R.E. ...	240	" " "	"	" "
"	" F. H. Grandy, R.E. ...	240	" " "	"	" "
"	" C. W. Heald, R.E. ...	240	" " "	"	28th Dec., 1910.
	Wallis Company Concessions.				
Draughtsman	Sapper D. Flanagan, R.E. ...	250	Nil	Temporary	8th Feb., 1911.
"	" B. J. Gee, R.E. ...	240	£90 commuted allowances.	"	" "
"	" L. Treacy, R.E. ...	240	" " "	"	" "
"	" M. M. Campbell, R.E.	240	" " "	"	" "
"	" E. G. L. Allen, R.E. ...	240	" " "	"	" "
"	" J. Foley, R.E.... ...	240	" " "	" (invalided 31–3–11).	" "
"	" W. O'Connell, R.E. ...	240	" " "	"	" "
"	" J. F. Fleming, R.E. ...	240	" " "	"	" "
"	" M. J. Kennedy, R.E....	240	" " "	"	" "
"	" H. R. Halliday, R.E. ...	240	" " "	"	" "
"	" W. L. Sheridan, R.E....	240	" " "	"	" "
"	" J. Ralph, R.E.... ...	240	" " "	"	" "

„	„ M. F. Dunne, R.E. ...	240	„ „ „	„	„ „
	NORTHERN NIGERIA.				
Intelligence Officer	Capt. H. N. Kempthorne Scots Fus.	400–20–500	£48 duty allowance, 2*s.* 6*d.* per diem horse allowance.	... ...	14th July, 1906.
Draughtsman	L.-Corpl. A. J. Turner, R.E. ...	200	£20 outfit allowance, 1*s.* per diem bicycle allowance.	... ...	July, 1909.
Surveyor	„ C. C. Crook, R.E. ...	200	... ...	1 year	29th March, 1911.
„	„ R. R. Rowland, R.E.	200	... ...	„	—
Native Cartographer	Mr. O. Gilbert	200	... ...	Permanent	1901.
Native Draughtsman	Vacant	... ...	... ...	... ...	—
	SOUTHERN NIGERIA.				
	Headquarters.				
Director of Surveys	Major F. G. Guggisberg, R.E., C.M.G.	900	£180 duty pay ...	5 years	1st April, 1910.
Chief Assistant	—	250–20–350	... ...	On probation 3 years...	—
Chief Clerk	D. Akitoye	252–12–300	... ...	Pensionable	1st Jan., 1911.
Finance Clerk	J. S. Williams	60–6–90	... ...	„	1st Jan., 1911.
Store Clerk	J. F. Kiyonmi	24–6–54	... ...	„	—
Director's Clerk	E. A. Ogunbiyi	24–6–54	... ...	„	—
Temporary Clerk	B. H. Johnson	36	... ...	Temporary	1st April, 1911.
Assistant Photographer ...	S. Dabiri	30	... ...	„	1st June, 1910.
„ „ ...	A. L. Ajiboye	21	... ...	„	1st June, 1910.
	Topographical Branch.				
Chief Assistant Director of Surveys.	Lieut. R. H. Rowe, R.A. ...	525	... ...	Temporary	21st Oct., 1910.
Assistant Director, Trigonometrical Section.	Lieut. G. G. Waterhouse, R.E.	525	... ...	3 or 5 years	10th Aug., 1910.
Assistant Director, Topographical Branch.	Lieut. H. E. Kentish, R.E. ...	525	... ...	3 or 5 years	30th Nov., 1910.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	Topographical Branch—continued.				
Assistant Director, Topographical Branch.	Mr. R. A. Webb	400–20–500	£80 duty pay ...	Pensionable	1st Jan., 1911.
Senior Surveyor	Mr. D. R. Meldrum	400–20–500	£80 duty pay ...	Probation, 3 years ...	13th March, 1909.
Surveyor	Mr. E. N. Thomas	300–20–400	... ...	Pensionable	1st Jan., 1911.
,, ...	Co. Sjt. Maj. K. Hackett, R.E.	275	... ...	3 years	10th Aug., 1910.
,, ...	L.-Corpl. J Gawthorne, R.E....	200	... ...	3 years	10th Aug., 1910.
,, ...	L.-Corpl. A. R. Trim, R.E. ...	200	... ...	3 years (to be relieved 20th Sept., 1911).	10th Aug., 1910.
,, ...	L.-Corpl. H. Clark, R.E. ...	200	... ...	3 years	10th Aug., 1910.
,, ...	L.-Corpl. C. Wharton, R.E. ...	200	... ...	3 years	10th Aug., 1910.
,, ...	L.-Corpl. A. Mullin, R.E. ...	200	... ...	3 years	10th Aug., 1910.
,, ...	Mr. F. H. Black	350	... ...	— (Resigned 17th Oct., 1910).	23rd Sept., 1905.
European Draftsman	Mr. C. H. Sweney	350	... ...	On probation (Resigns about October, 1911).	13th Dec., 1909.
Chief Native Surveyor ...	J. C. Johnston	200–10–250	... ...	Pensionable	1st April, 1911.
,, ,, ,, ...	V. L. Coker	200–10–250	... ...	— (Resigned 1st June, 1911).	1st April, 1911.
2nd Class Native Surveyor ...	A. O. Craig	72–6–90	... ...	3 years from 1st Oct., 1911. Pensionable.	1st Jan., 1911.
,, ,, ,, ,, ...	G. H. Euba	72–6–90	... ...	,, ,, ,,	,, ,,
3rd ,, ,, ,, ...	E. S. S. Wood	48–6–60	... ...	,, ,, ,,	,, ,,
,, ,, ,, ,, ...	E. O. Aiyede	48–6–60	... ...	,, ,, ,,	,, ,,
4th ,, ,, ,, ...	J. B. Cole	40–4–48	... ...	3 years from 1st Oct., 1911.	,, ,,
,, ,, ,, ,, ...	R. A. Williams	40–4–48	... ...	,, ,, ,,	,, ,,
,, ,, ,, ,, ...	A. A. Young	40–4–48	... ...	3 years from 1st Oct., 1912.	,, ,,
1st Class Native Draughtsman	J. A. Pratt	96–6–150	... ...	Pensionable	,, ,,

„ „ „ ...	G. J. Goyea	96–6–150	„	„ „
3rd „ „ „ ...	E. A. Aileru	48–6–60	3 years' probation ...	„ „
Temporary Draughtsman ...	B. B. Sanya	36	2 years' probation ...	1st Jan., 1910.
„ „ ...	S. Cole	18	On probation	29th April, 1911.
Temporary Native Surveyor...	G. W. Hyde	84	Temporary. Left the Survey 31st Dec.,1910.	——
„ „ „ ...	G. B. Carvatho	42	On probation. Dismissed 2nd May, 1911.	——
„ „ „ ...	W. A. West	—	On probation. Sent back to Intelligence Office 8th December, 1910.	——
	Cadastral Branch.			
Deputy Director of Surveys ...	Mr. A. Cleminson	500–20–600	£100 duty pay ...	Pensionable ... ... 29th Oct., 1906.
Surveyor	Mr. R. L. Drouyn	300–20–400		„ ... ... 1st Jan., 1911.
Temporary Surveyor	Mr. J. Scott	350	Temporary. Resigned Jan. 1911.	6th June, 1908.
Chief Native Surveyor ...	J. B. Benjamin	200–10–250	Temporary. Resigned 18th Jan., 1911.	1st Jan., 1907.
1st Class Native Surveyor ...	I. T. Wey	96–6–150	Pensionable	1st Jan., 1911.
Temporary „ „ ...	M. T. Betts	96–6–150	Appointment terminated 1st Mar., 1911.	18th Sept., 1910.
3rd Class „ „ ...	R. Jones	48–6–60	Probation 3 years. Pensionable.	1st Jan., 1911.
4th „ „ „ ...	O. Olumide	40–4–48	Probation 3 years ...	1st April, 1911.
1st Class Native Draughtsman	A. A. Creppy	96–6–150	Pensionable	1st Jan., 1911.
2nd Class „ „	H. St. J. Williams	72–6–90	„	1st April, 1911.
4th Class „ „	F. I. George	40–4–48	Resigned January, 1911	——
Temporary „ „	Mendes	40	Temporary on probation	1st June, 1911.
Clerk	S. Wilson	24–6–54	Pensionable	1st Jan., 1911.
	School and Meteorological.			
Chief Instructor	Mr. W. F. Hale	450–10–500	£90 duty pay ...	Transferred to Ija Water Supply, Oct., 1910. 17th Feb., 1909.
„ „	A. A. A. Barnes	252–12–300	On probation	1st Jan., 1911.
Meteorological Clerk	E. E. Solomon	24–6–54	Pensionable	„ „

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	School and Meteorological—continued.				
Pupil Surveyor	S. O. Isaacs	35	... ...	... ...	1st July, 1910.
" "	E. S. Vincent	30	... ...	... ...	" "
" "	A. Pedro...	30	... ...	... ...	" "
"	J. J. A. Cole	30	... ...	... ...	" "
Pupil Draughtsman	W. F. Sancho	30	... ...	... ...	" "
Pupil Surveyor	H. R. Hoskyns	30	... ...	... ...	" "
" "	J. L. Tete	20	... ...	... ...	" "
" "	H. M. Williams...	20	... ...	... ...	" "
" "	A. C. B. Cole	20	... ...	... ...	" "
" "	J. T. Bamgboshe	20	... ...	... ...	" "
" "	C. B. A. John	20	... ...	... ...	" "
" "	J. J. Mediros	20	... ...	... ...	" "
Pupil Draughtsman	G. E. Elias	12	... ...	... ...	1st March, 1911.
" "	G. G. Cole	12	... ...	... ...	" "
" "	S. I. Shabi	9	... ...	Dismissed 20th May, 1911, as unfitted for draughtsman.	" "
" "	V. A. Dawodu	9	... ...	... ...	" "
Temporary Draughtsman ...	V. Williams	6	... ...	... ...	" "
" " ...	M. J. Martins	6	... ...	... ...	" "
" " ...	S. O. John	6	... ...	... ...	" "
" " ...	Seton	6	... ...	Dismissed 16th May, 1911, as unfitted for draughtsman or surveyor.	" "
	UGANDA.				
Director of Surveys	Mr. R. C. Allen	500–700, by £25.	... ...	... ...	30th Nov., 1900.

Deputy Director of Surveys ...	Mr. W. V. Morris	325–425, by £20.	... ...	... ...	27th July, 1902.
Senior Surveyor	Mr. E. Richardson	360–20–400	... ...	3 years' agreement (Re-engaged for 3 years).	8th April, 1904.
„ „	Mr. E. G. Fenning	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
„ „	Mr. L. R. Fraser	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
Junior Surveyor	Mr. A. Richardson	300	... ...	3 years' agreement (Re-engaged for 30 months).	1st June, 1903.
„ „	Mr. J. T. W. S. McGregor ...	300	... ...	3 years' agreement (Re-engaged for 3 years).	17th July, 1903.
„ „	Mr. H. Boazman	350	... ...	3 years' agreement (Re-engaged for 30 months, 12/2/07).	17th July, 1903.
„ „	Mr. J. P. Tolland	300	... ...	3 years' agreement from date of arrival in Africa (not reported).	—
„ „	Mr. A. H. Gee	300	... ...	„ „ „	—
„ „	Mr. W. A. Khan	?	... ...	„ „ „	—
„ „	Mr. V. F. Mayne	300	... ...	Resigned 31st Dec., 1910	—
		NYASALAND			
Director of Public Works ...	Mr. T. I. Binnie	450–600, by £25.	£100 personal ...	Permanent	15th March, 1897.
Assistant Director of Public Works.	Mr. T. J. Firr	325–425, by £25.	£12 10s. electric light.	„	26th April, 1902.
Assistant Surveyor	Mr. J. Bannerman	325–425, by £20.	„ „ „	„	1st June, 1901.
„ „	Mr. G. N. Beaumont	250–350, by £10.	„ „ „	„	5th Dec., 1908.
Clerk	Mr. E. Taylor	200–300, by £10.	£20 subsistence ...	... ...	6th July, 1906.
„	Mr. H. R. Cruise	200–300, by £10.	„ „ ...	... ...	25 Oct., 1906.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	JAMAICA.				
Surveyor-General	Mr. Colin Liddell	500	Actual travelling expenses.	Permanent	1st Oct., 1890.
Assistant Surveyor	Mr. W. A. Baker	300	" " "	"	1st April, 1905.
" "	Mr. H. D. Rogers	200	" " "	Temporary	17th April, 1905.
2nd Class Clerk	Mr. E. G. Wilson	160	... ...	Permanent	1st Mar., 1893.
Assistant Clerk	Mr. V. N. Smith	89	... ...	"	19th Feb., 1909.
Typist	Mr. A. R. Nunn	60	... ...	Temporary	6th July, 1910.
Clerk	Mr. R. G. Smith	60	... ...	"	5th Aug., 1910.
	TRINIDAD.				
	Crown Lands Branch.				
Engineer in Charge of Surveys	Mr. E. R. Smart	500	£100 travelling allowance.	... ...	1st June, 1910.
1st Assistant	Mr. R. Kernahan	350	" " "	... ...	1st Jan., 1898.
2nd "	Mr. J. W. Dumanoire	250	" " "	... ...	10th Nov., 1903.
1st Draughtsman	Mr. T. Sorzano	225	£75 personal allowance.	... ...	18th July, 1874.
2nd "	Mr. Th. Sorzano	150	... ...	... ...	12th Nov., 1881.
3rd "	Mr. F. Sorzano	125	... ...	... ...	1st April, 1907.
4th "	Mr. P. Dumanoire	75	... ...	... ...	1st Aug., 1910.
Clerk	Mr. A. W. Hunt	100	... ...	... ...	15th May, 1901.

		Trigonometrical Branch.					
Officer in Charge	Mr. E. R. Smart	150	15*s.* per diem field allowance.	... ...	1st April, 1901.
1st Assistant	Mr. J. W. Macgillivray ...	350	12*s.* 6*d.* per diem field allowance.	... ...	„ „
2nd „	Mr. J. G. Reece	250	8*s.* 4*d.* per diem field allowance.	... ...	1st April, 1904.
3rd „	Mr. C. E. Laurie	150	6*s.* 3*d.* per diem field allowance.	... ...	1st Aug., 1903.

Office.	Name.	Salary.	Date of First Appointment.
	BRITISH HONDURAS.		
		$	
Surveyor-General ...	Mr. H. I. Perkins, I.S.O.	3,402	18th Oct., 1905.
Assist. Surveyor-General	Mr. W. H. Carlin ...	1,944	1st April, 1896.
Assistant Surveyor ...	Mr. W. Cunningham ...	1,701	15th Oct., 1906.
" " ...	Mr. F. W. Brunton ...	1,458	13th Nov., 1903.
" " ...	Mr. C. la T. Franks, B.A.	1,458	25th Feb., 1907.
" " ...	Mr. L. E. Williams ...	1,458	1st Jan., 1906.
Temporary Surveyor ...	Mr. G. L. Ridley ...	1,458	1st Jan., 1909.
" " ...	Mr. A. N. Wolffsohn ...	720	1st Jan., 1911.
Forest Officer	Mr. J. L. Brown ...	600–60–900	1st June, 1896.
" "	Mr. G. Hulse	600–60–840	1st Jan., 1910.
2nd Class Clerk	Mr. D. Rosado	480–30–720	16th May, 1907.
Draughtsman	Mr. E. Lassen	360–20–480	1st Dec., 1909.
	CYPRUS.		
		£	
Chief Surveyor	Mr. G. A. Douglas ...	175	1st Oct., 1903.
Surveyor	Mr. H. Feneck	150	16th May, 1910.
"	P. Avraamides	108	1st May, 1909.
Chief Draughtsman ...	M. Salim	130	1st Dec., 1896.
7 Surveyors	... ...	346 (total for the 7 men).	... ...
10 Draughtsmen... ...	... ...	258 (total for the 10 men).	... ...
	CEYLON.		
Surveyor-General ...	*Mr. R. S. Templeton ...	Rs.13,500–16,875†	15th Oct., 1887.
		£	
Deputy Surveyor-General	*Mr. W. C. S. Ingles ...	700–50–800	4th Jan., 1890.
Assistant " "	*Mr. H. O. Barnard ...	700–50–800	4th Dec., 1890.
Superintendent, Application Surveys.	*Mr. A. J. Wickwar ...	500–25–600	1st Sept., 1889.
Superintendent, Waste Lands Surveys.	*Mr. J. B. M. Ridout ...	Rs.8,312–50‡	1st Nov., 1888.
		£	
Superintendent of Surveys.	*Mr. L. Shipton ...	500–25–600	4th Sept., 1884.
" " "	*Mr. C. Meaden ...	500–25–600	1st Nov., 1890.
" " "	*Mr. A. H. G. Dawson...	400–25–450	16th Dec., 1895.
" " "	*Mr. H. Erskine ...	400–25–450	1st Mar., 1876.
" " "	*Mr. C. F. W. Halliley...	400–25–450	1st Mar., 1891.
" " "	*Mr. C. R. Lundie ...	400–25–450	13th Feb., 1904.
" " "	Mr. A. J. Stronach ...	400–25–450	30th June, 1906.
Assistant Superintendent of Surveys.	*Mr. J. W. Robertson ...	300–25–350	17th June, 1885.
" " "	*Mr. G. F. Hepponstall	300–25–350	23rd Sept., 1886.
" " "	*Mr. A. E. Dirckze ...	300–25–350	1st Oct., 1889.
" " "	*Mr. D. Bloxham ...	300–25–350	5th Oct., 1907.
" " "	*Mr. G. K. Thornhill ...	300–25–350	15th July, 1901.
" " "	*Mr. C. H. Vince ...	300–25–350	13th June, 1908.
" " "	*Mr. F. J. Salmon ...	300–25–350	13th June, 1908.
" " "	*Mr. L. G. O. Woodhouse	300–25–350	1st Aug., 1905.
" " "	*Mr. J. A. Loram ...	300–25–350	30th July, 1908.
" " "	*Vacant	300–25–350	—
" " "	Mr. H. M. C. Ledger ...	300–25–350	13th June, 1908.
" " "	Mr. E. B. Manson ..	300–25–350	13th June, 1908.
" " "	Mr. R. W. E. Ruddock...	300–25–350	5th Nov., 1908.
" " "	Mr. P. J. May	300–25–350	6th May, 1909.
" " "	Mr. N. B. Favell ...	300–25–350	6th May, 1909.
" " "	Mr. F. L. Baker ...	300–25–350	6th May, 1909.
" " "	Mr. K. W. S. Mitchell...	300–25–350	6th May, 1909.
" " "	Mr. H. P. Harrison ...	300–25–350	20th May, 1909.

LIST OF STAFFS.

Office.	Name.	Salary.	Date of First Appointment.
	CEYLON—*cont.*		
		£	
Assistant Superintendent of Surveys.	Mr. B. C. Johnstone ...	300–25–350	21st Oct., 1909.
" " "	Mr. H. O. Clark ...	300–25–350	21st Oct., 1909.
" " "	Mr. C. C. S. Stephenson	300–25–350	21st Oct., 1909.
" " "	Mr. B. S. Coventry ...	300–25–350	19th Nov., 1909.
" " "	Mr. O. G. Peterkin ...	300–25–350	15th Jan., 1910
" " "	Mr. P. E. L. Gethin ...	300–25–350	1st April, 1910
" " "	Vacant	300–25–350	—
Assistant Superintendent of Surveys. (Field Staff.)	Corpl. P. B. Lynch ...	250–10–300	22nd May, 1908.
" " "	Sapper F. E. Dainty ...	250–10–300	5th June, 1908.
" " "	Sapper G. A. Robertson	250–10–300	5th June, 1908.
Assistant Superintendent of Surveys. (Office Staff.)	Mr. W. W. A. Wall ...	300–10–350	5th Nov., 1908.
" " "	Corpl. H. W. Johnson ...	300–10–350	22nd May, 1908.
" " "	L.-Corpl. E. E. O'Leary	300–10–350	22nd May, 1908.
" " "	Corpl. W. F. Hawkesworth.	300–10–350	18th June, 1909.
" " "	2nd Corpl. W. S. Maddams	300–10–350	18th June, 1909.
" " "	2nd Corpl. R. B. Crusher	300–10–350	18th June, 1909.
" " "	Sergt. A. Plested ...	300–10–350	9th Sept., 1910.
Assistant Astronomer ...	Mr. A. J. Bamford ...	350–15–380	31st Oct., 1908.

* Permanent appointment.
† By biennial increments of Rs.1,125.
‡ Includes a personal allowance of Rs.1,000.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
651	Tongan Islands Protectorate	1909–1910
652	Bechuanaland Protectorate	"
653	Ceylon	1909
654	Gold Coast	"
655	Nyasaland	1909–1910
656	Imperial Institute	1909
657	Fiji	"
658	Grenada	"
659	Hong Kong	"
660	Barbados	1909–1910
661	Swaziland	"
662	Jamaica	"
663	Straits Settlements	"
664	Trinidad and Tobago	"
665	Southern Nigeria	1909
666	Mauritius	"
667	British Honduras	"
668	St. Vincent	1909–1910
669	East Africa Protectorate	"
670	Uganda	"
671	British Guiana	"
672	St. Lucia	1909
673	Leeward Islands	1909–1910
674	Northern Nigeria	1909
675	St. Helena	1910
676	Gibraltar	"
677	Basutoland	1909–1910
678	Weihaiwei	1910
679	Gambia	"
680	Ashanti	"
681	Turks and Caicos Islands	"
682	Falkland Islands	"
683	Northern Territories of the Gold Coast	"
684	Bahamas	1910–1911

MISCELLANEOUS.

No.	Colony, &c.	Subject.
69	St. Helena	Fisheries.
70	Colonies	List of Laws relating to Patents, Trade Marks, &c.
71	Imperial Institute	Foodstuffs.
72	Fiji	Hurricane, 1910.
73	Jamaica	Cayman Islands.
74	Ceylon	Mineral Survey, 1906–7 and 1907–8.
75	West Indies	Imperial Department of Agriculture.
76	Southern Nigeria	Mineral Survey, 1907–8.
77	St. Vincent	Roads and Land Settlement Fund.

COLONIAL REPORTS—ANNUAL.

No. 730.

THE SURVEYS

OF

BRITISH AFRICA, CEYLON, CYPRUS, FIJI, JAMAICA, TRINIDAD, BRITISH HONDURAS.

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

SEVENTH YEAR.

To 31st March, 1912.

(For Report for 1910–11, *see* No. 685.)

Presented to both Houses of Parliament by Command of His Majesty.
September, 1912.

LONDON:
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.
To be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LIMITED, FETTER LANE, E.C., and
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T. FISHER UNWIN, LONDON, W.C.

PRINTED BY
DARLING AND SON, LTD., BACON STREET, E.
1912.

[Cd. 6007—30.] *Price* 1*s.* 1*d.*

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Progress of delimitation of boundaries of Africa	to face p. 37.

No. 730.

COLONIAL SURVEY COMMITTEE REPORT.

FOR THE YEAR ENDING 31ST MARCH, 1912.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

H. J. READ.
C. F. CLOSE, *Colonel, D.G.O.S.*
W. C. HEDLEY, *Lt.-Col., Gen. Staff.*

W. C. BOTTOMLEY,
W. J. JOHNSTON, } *Secretaries.*
Major, G.S.

September, 1912.

(25649—2.) Wt. 29478—571. 1125 & 90. 9/12 D & S. A 2

I.

REVIEW OF WORK IN AFRICA DURING THE PAST YEAR.

Topographical Surveys.—During the past year a total of about 30,000 square miles has been topographically surveyed in British Africa. The most important areas are :—

Cape of Good Hope	...	...	...	10,500	sq. miles.
Orange Free State	...	...	...	2,600	„ „
Transvaal	...	..	...	600	„ „
East Africa	...	...	...	6,950	„ „
Uganda	...	...	...	2,375	„ „
Southern Nigeria	...	...	...	5,598	„ „
Gold Coast	...	...	...	445	„ „
Pemba Island	...	...	...	380	„ „

Maps Published.—A map of Basutoland in four sheets has been published on the scale of $\frac{1}{250000}$.

Eight sheets of Uganda on the scale of $\frac{1}{250000}$ covering an area of 30,000 square miles and consisting of the work of Capt. Macfie, Mr. Allen, Lieutenant Fishbourne and others were published during the year. This is the largest block of topographical mapping in tropical Africa which has yet been issued and indicates very clearly the great advance made in recent years in the extent and accuracy of the surveys of that Continent.

A sheet of the International 1 : 1,000,000 Series, South H. 34, was prepared and published.

Geodesy.—The report on the measurement of the Uganda arc, Volume I., was completed and is now being printed.

Cadastral Surveys have been in progress in East Africa, Gold Coast, Southern Nigeria, and Uganda.

Boundary Commissions :—

(i.) The boundary commission appointed to delimit the frontier between Uganda and the Congo, in the 'Mfumbiro district, and also the Uganda-German East African boundary to the east of Mount Sabinio, completed it work in August, 1911.

(ii.) A meeting took place in June, 1911, between representatives of the Belgian and British Governments to discuss the procedure and methods of work to be employed on the Rhodesia-Congo boundary commission. The commissioners left Europe in July, 1911, and met at Sakania on the 1st September, 1911. This frontier is over 1,100 miles in length and it is estimated that the work will extend into 1914, and the result of their labours should add largely to the geographical knowledge of this portion of the Empire.

(iii.) Preliminary arrangements have been made to appoint commissioners to delimit the boundary between Rhodesia and the Portuguese colony of Angola. It is hoped that the Commissioners will rendezvous at the junction of the Congo-Zambesi watershed with the 24th meridian east of Greenwich on or about the 21st March, 1913.

(iv.) The boundary between Southern Nigeria and the German Kameruns, lying between Yola and the Cross River, has been ratified since the close of the year under review, and it is hoped to send out a commission, under one of the officers employed on the original boundary commission, to mark out the new boundary on the spot.

(v.) A commission left Sierra Leone in 1911, to delimit the new boundary between that colony and Liberia. Owing to unexpected difficulties, the commission made practically no progress and has now returned to Freetown.

II.

REGULATIONS AFFECTING SURVEY DEPARTMENTS.

Appointments to Survey Departments.

NOTE.—These regulations supersede those contained in the last report and are subject to revision from time to time.

The Secretary of State for the Colonies has approved of the following arrangements for the selection of candidates for junior survey appointments in Crown Colonies and Protectorates.

1. For the purpose of selecting surveyors, Ceylon, the Federated Malay States, and the East Africa* and Uganda Protectorates will be grouped, and candidates will be required to pass the same tests and go through the same preliminary training. Candidates will, however, be allowed to indicate their preference for particular Colonies, and, if they wish it, to await the occurrence of vacancies. It is possible that other Colonies or Protectorates may be included in these arrangements in the future, but for the present they will apply only to the countries named, which are those in which vacancies may be expected to occur most frequently.

2. Candidates must be between the ages of 21 and 27 and should be unmarried, as the conditions of service for surveyors in the countries concerned are not suitable for a married man.

3. Anyone wishing to become a candidate for these posts should apply in writing to the Private Secretary to the Secretary of State, Colonial Office, London, S.W. He will be required to fill in a form of application and to furnish testimonials and the names of two referees. If the information thus obtained is considered satisfactory, he will be asked to call at the Colonial Office for a personal interview, and, if accepted, will be nominated as a candidate.

4. A candidate not exempted under paragraphs 5 or 6 of this Memorandum will be required to pass two tests:—

(*a.*) A qualifying examination in mathematics, including algebra, geometry and plane trigonometry, and

(*b.*) A qualifying examination in the use and adjustment of surveying instruments. This examination will include

* The extent to which the arrangements can be applied to the East Africa Protectorate is at present uncertain.

the theodolite, level, compass, chain, tape, plane table, clinometer and barometer. It is not, however, necessary that the candidate should have had other than academical experience of the use of these instruments.

For these examinations, which will be conducted at the Surveyors' Institution, an examiner nominated by the Secretary of State will be associated with the examiners nominated by the Institution. The candidate will be required to pay a fee of one guinea for each examination.

5. A candidate who has passed with honours in mathematics, physical science or engineering, or who has obtained an equivalent diploma or distinction, in a University or school of a University in the United Kingdom, or who has been licensed to practice as a surveyor in one of His Majesty's Dominions, will not be required to undergo any technical or educational test.

6. A candidate who has passed the examination for the Associated Membership of the Institute of Civil Engineers or for the Professional Associateship or Fellowship of the Surveyors' Institution, or the examination of the Institution of Municipal and County Engineers, or who has obtained the surveying diploma of the Royal Geographical Society or the diploma of the Cambridge University Department of Geography, will be exempt from the technical test referred to in paragraph 4 (*b*) above.

7. Candidates who have passed the qualifying tests or have been exempted will then be required to undergo a medical examination by one of the medical advisers to the Colonial Office in London, Liverpool, Edinburgh, or Dublin. A fee of one guinea will be charged for this examination.

8. According to the number of vacancies, candidates will then be sent to the Ordnance Survey Office, Southampton, for a course of instruction not exceeding two months. If reported on favourably by the Director-General of the Ordnance Survey, but not otherwise, a candidate will become a Survey Probationer and will be granted the amount of his actual railway fares* incurred in connexion with the course, and a lodging allowance of 2*s.* 6*d.* a day and a subsistence allowance of 5*s.* a day for each day spent at Southampton. No travelling expenses other than first class railway fares will be admitted, and return tickets must be taken when any saving would be effected thereby.

9. If the number of candidates reported on favourably by the Director-General of the Ordnance Survey is in excess of the number of vacancies then in existence, the selection of those Probationers first to be sent out will be at the discretion of the Secretary of State. The remainder will be placed on a waiting list pending the occurence of vacancies. No salary or allowance can be issued during the period of waiting, but a Probationer on the waiting list will have priority over all candidates for Probationerships who attend a subsequent course of instruction unless for any reason he desires his allocation to a particular Colony or Protectorate to be deferred. In the latter event he will be allowed to remain on the list for a further period not exceeding 12 months.

* Travelling expenses are not granted in respect of the candidate's call at the Colonial Office or his qualifying or medical examinations.

10. A Survey Probationer will be sent out to the Colony or Protectorate to which he is posted at a salary of £250 a year (£275 in the Federated Malay States), with free quarters or an allowance in lieu thereof when stationed at headquarters.* He will be provided with a free passage on his signing an agreement to refund its cost in the event of his leaving the service of the Government during the period of probation or, in the event of his services being retained, within three years of the date of his arrival for any reason other than physical or mental infirmity. Passages booked by mail steamer to Ceylon or the Federated Malay States are second class, but in all other cases first class passages are provided. He will draw half pay on the voyage out and will not begin to draw full pay until his arrival in the Colony or Protectorate.

11. At the end of one year he will, if approved by the Surveyor-General or Director of Surveys, be appointed to the Department at the ordinary rate of pay attached to junior survey appointments. Generally speaking, the appointment will be for three or five years in the first instance, with a prospect of re-engagement if the surveyor's service continues to be satisfactory. In the Federated Malay States a surveyor may be placed on the pensionable establishment after not less than three years' satisfactory service as a second-grade surveyor. In Ceylon, also, a surveyor has a prospect of ultimate appointment to the permanent establishment, while in Uganda nine and in East Africa only two of the appointments in the Survey Department are permanent and pensionable.

12. The rates of salary payable after the expiration of the period of probation are as follows :—

Ceylon.—Assistant Superintendent of Surveys	£300 to £350 a year by annual increments of £10.
Federated Malay States.—Second-Grade Surveyor	£300 to £360 a year by annual increments of £10.
East Africa and Uganda.—Junior Staff Surveyor	£250 to £280 a year by annual increments of £15.

13. If at the end of a year's probation a Probationer is not approved, his appointment will be terminated, and he will have no claim to any compensation beyond a free passage back to England. The probationary period of one year may, however, be extended at the discretion of the Governor or High Commissioner if the extension is recommended by the Surveyor-General or Director of Surveys on account of special circumstances.

14. The Secretary of State does not by these arrangements preclude himself from considering an application for appointment from a Surveyor who is fully qualified in the practice of his profession but whose case cannot be dealt with under the ordinary procedure for filling Survey Probationerships.

* In Ceylon free quarters are not available and a house allowance of £50 a year is provided.

The qualifying examination in Mathematics referred to in paragraph 4 (*a*) will be conducted in accordance with the following syllabus :—

Algebra	Up to quadratic equations and problems involving their solution.
Geometry	Alternative papers will be set :— (*a.*) Euclid, first six books. (*b.*) Theoretical and practical Geometry up to an equal standard.
Mensuration ...	Areas of plane figures.
Plane Trigonometry	Up to the solution of triangles, with applications to heights and distances. The use of trigonometrical and logarithmic tables.

Three papers will be set: (I.) in algebra, (II.) in geometry and mensuration, and (III.) in plane trigonometry. Three hours will be allowed for each paper.

The questions in each paper will be arranged with a view to testing the candidates' ability and accuracy in arithmetical work.

One hundred marks will be allotted to each paper.

Candidates who obtain 165 marks in the three papers will be considered to have qualified.

It is to be understood that, while the examination is not competitive in the sense that the candidate who stands highest on the list will have any claim to priority of consideration, the marks obtained will be taken into account by the Secretary of State in comparing the merits of the various qualified candidates.

III.

REPORTS ON THE SURVEYS OF BRITISH AFRICA.

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NIGERIA, NORTHERN	17
NIGERIA, SOUTHERN	18
NYASALAND	23
PEMBA ISLAND	24
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UGANDA	25

THE ANGLO-EGYPTIAN SUDAN.

Governor-General	...	Lt.-General Sir F. R. WINGATE, G.C.V.O., K.C.B., K.C.M.G., D.S.O.
Director of Surveys	...	Captain H. D. PEARSON, R.E.
Assistant-Director of Surveys ...	...	Vacant.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but it has been thought desirable to include an account of these surveys in order to make the review of the mapping of British Africa more complete.

EXISTING STATE OF TOPOGRAPHY.

127 sheets, on the $\frac{1}{250000}$ scale, have been published. These depend chiefly on rapid reconnaissance work. Four sheets on the $\frac{1}{1000000}$ scale have also been issued.

THE WORK OF THE PAST YEAR.

Captain Coningham, R.E., the only officer employed exclusively on topographical survey, reverted to the home establishment in January, 1912. His successor has not yet been appointed. During last season Captain Coningham was at work in the Lado Enclave and his triangulation covers most of the country west of the Nile between 3° 30′ and 5° parallels of latitude as far west as the 30th meridian.

In Kordofan, triangulation has been carried from J. Eliri to Dar El Kebir near the 29th meridian and extended northwards from Talodi to Tagale and Abu Dom via Tandik. Hill sketching is here very faulty, and several seasons' work is still necessary before maps of sufficient accuracy for present needs can be issued, comprising the whole of the Jebel Sub-Province. In the meantime revised editions continue to be issued, embodying the compass route sketches furnished by the inspectors of the province, adjusted to triangulated stations.

Further north, a survey of the Kheiran has lately been completed, and topographical triangulation is going on between Kagmar and Khartoum.

The recent expedition to the Beir Country furnished an opportunity for exploration to the east of the Bahr-el-Jebel. The route of the southern column skirted the hills to the south of the 5th parallel, and the peaks visible from the various camps enabled the longitude to be carried as far east as the 34th meridian with approximate accuracy.

The other columns followed the Pilor as far south as the 6° 30′ parallel of latitude at which point the river had three distinct channels. A strip 100 miles wide between the country

traversed by the northern and southern columns could not be visited for want of water, but there is some prospect of further exploration being made by steamer at High Nile.

Two new million scale sheets have also been issued, viz., Kordofan and the Northern Bahr-el-Ghazal. The Upper Nile sheet is now being revised and brought up to date in Cairo.

The area of the Anglo-Egyptian Sudan is roughly one million square miles, and the average annual expenditure of the topographical branch of the Survey Department is £E2,240 per annum.

Cadastral Survey.—The survey of the low-lying river lands of the Geteina District of the White Nile has been completed. In the Gezira the survey of Kamlin, Mesellemia, and Wad Medani, comprising an area of approximately 1,200,000 feddans* has also been finished in detail.

The whole of the land between the Blue and the White Niles as far south as the 14° 15′ parallel of latitude, upwards of 3½ million feddans have now been laid out into squares with sides one minute of arc. Further south, thick bush would render a continuation of this system of land demarcation expensive, and it will be necessary to adopt some other method of survey.

Recent cotton growing experiments have shown that the value of land in the Gezira may be very great, and the Sennar District is now being examined with a view to preparing a scheme of survey.

The cost of the Gezira survey to date has been £E44,698, an average of 37 milliems, roughly 9*d.* per feddan.

This figure is arrived at by dividing the total area surveyed in detail in the field into the total expenditure. The computation of areas of the above, however, has only been about half completed. On the other hand, no credit is taken for upwards of two million feddans which have been demarcated by beacons at intervals of a minute of arc. The size of individual holdings surveyed near the river is about five feddans, while in the interior the plots average between 30 and 40 feddans.

Town Survey.—The town survey of Omdurman on $\frac{1}{500}$ scale has been completed. In all 12,714 compounds have been mapped.

The staff is now actively engaged on allotting compensation plots on a new alignment of roads and alley ways, and though it is estimated that some four thousand have already been so allotted most of the energy of this section of the department seems likely to be expended on the work for many years.

The survey of the town of Khartoum North is in hand on the scale $\frac{1}{1000}$. The work is not difficult, and could be completed in a few months could the staff be released from their duties in connection with the building operations in Omdurman.

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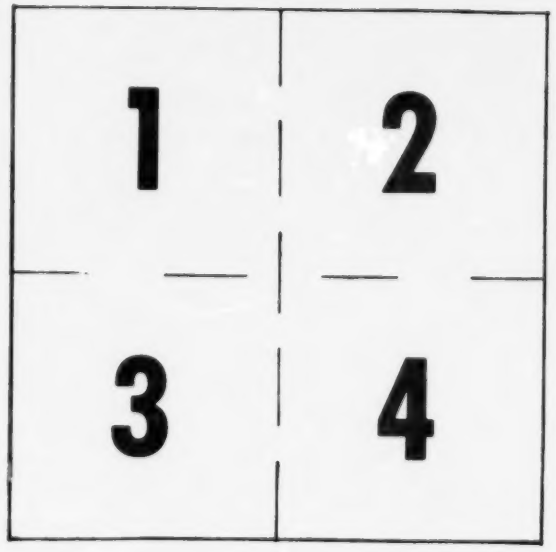
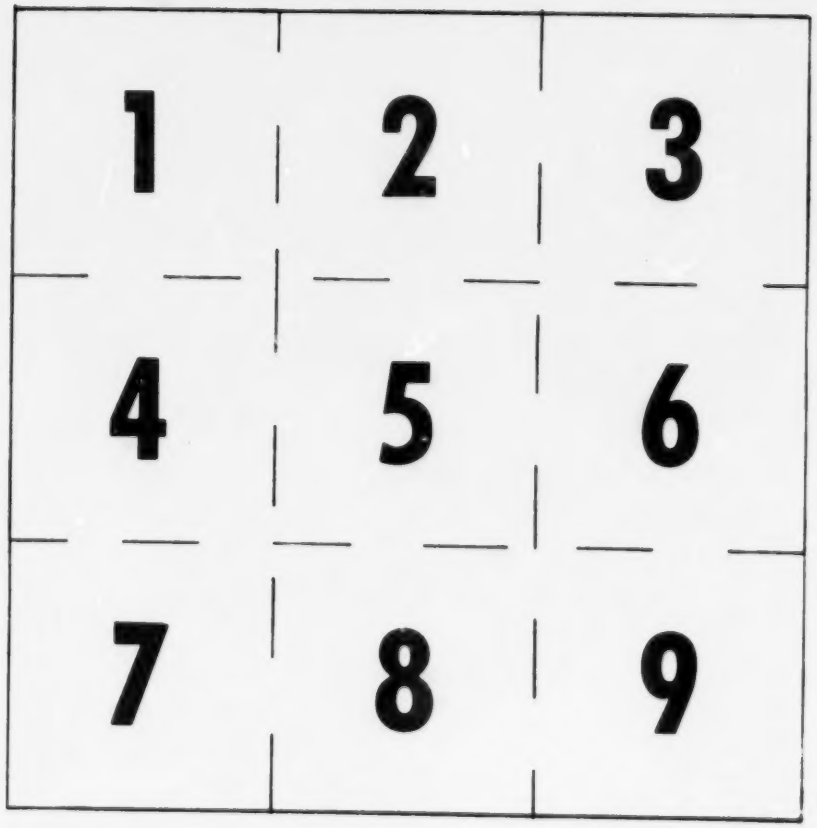
* A feddan equals roughly an acre.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.

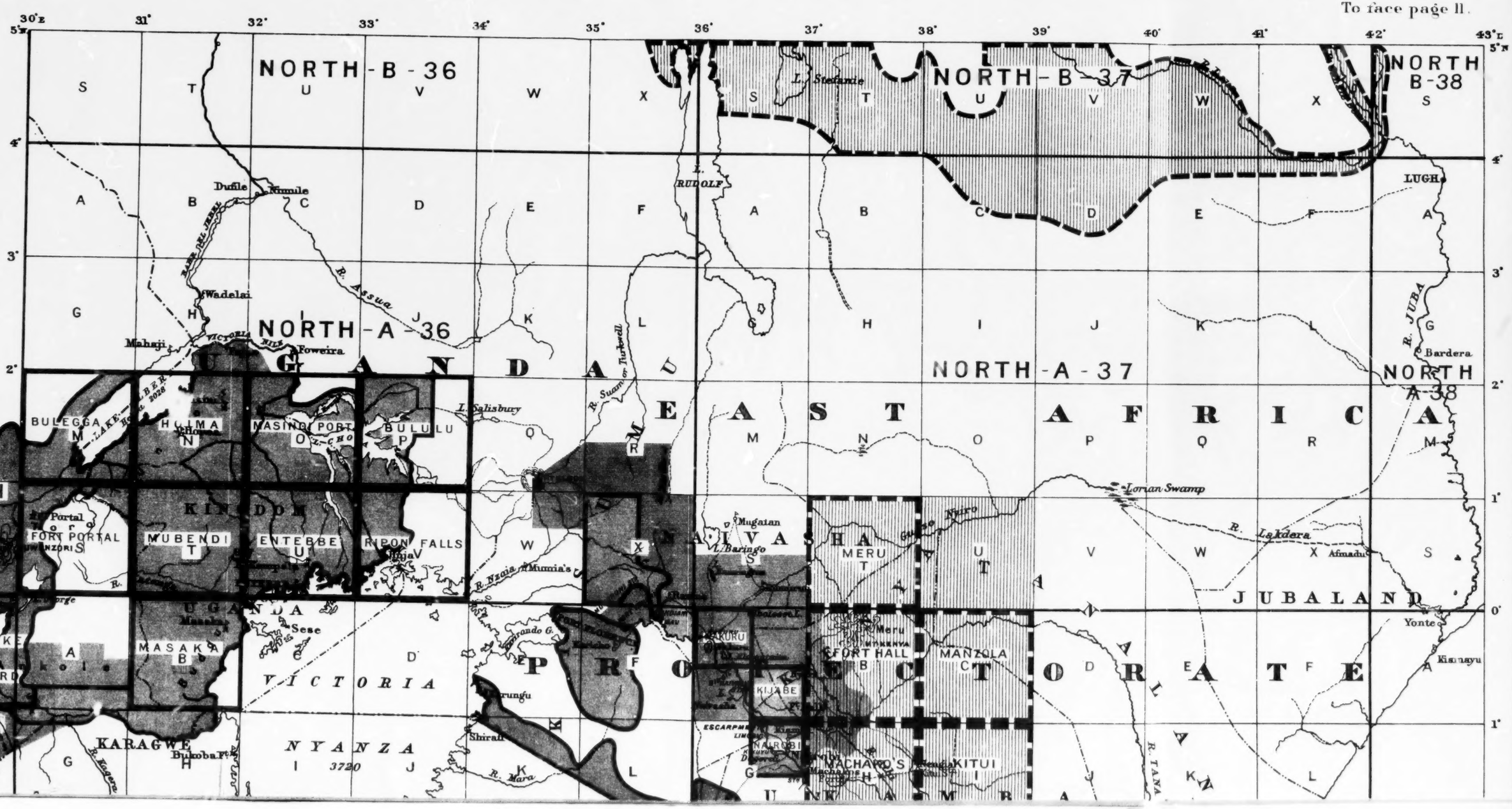




INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA

To face page 11.



NORTH A-35 | NORTH-A-37 | NORTH A-38

SOUTH A-36 | SOUTH-A-37 | SOUTH A-38

SOUTH-B-36 | SOUTH-B-37

BULEGGA | HOIMA | MASINDI PORT | BULULU

FORT PORTAL | MUBENDI | ENTEBBE | RIPON FALLS

MASAKA | KISUMU | KERICHO | NAKURU | NAIROBI | FORT HALL | MANZOLA | MACHAKOS | KITUI | MAKINDU | YATTA PLATEAU | MANGEA | MALINDI | TAKAUNGU | MOMBASA

EDWARD | VICTORIA | NYANZA | KARAGWE | KIJABE | MERU | JUBALAND | KISMAYU | KAMBA | TANA

Portal | Sese | Bukoba | Shirati | Olgos | Muansa | Mugatan | L. Baringo | Lorian Swamp | Afmadu | Yonte | Witu | Lamu | Moshi | Jipe | Vanga | Wilhemstal | Tanga | Pangani | Pemba Id.

L. Salisbury | R. Suam | R. Nzoia | Mumia's | Serengeti G. | Rungu | R. Mara | L. Natron | MT KILIMA | MT MERU | R. Tana | R. Uaso Nyiro | R. Lagdera

L. KIVU | R. Kagera | L. EDWARD 3000 | LAKE EDWARD 3000 | LAKE

S T G E R M A N W E A S T A F R I C A

E A S T A F R I C A

REFERENCE

Telegraph lines
Railways
Cart roads
Cleared (Trade) routes
Caravan tracks
Gov.t Stations

30°E | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | 41° | 42° | 43°E

2°S | 3°S | 4°S | 5°S | 1° | 0° | 1° | 2°

Geographical Section, General Staff; No 2291.(a)

Topography completed in the field
Topography published
Sheets published
Provisional sheets compiled 1:250,000
" " published "

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

Revised, July, 1912

EAST AFRICA PROTECTORATE.

Governor	Colonel Sir E. P. C. GIROUARD, K.C.M.G., D.S.O.
Director of Surveys	Captain G. S. KNOX, R.E.
Deputy Director of Surveys, Trigonometrical and Topographical Branch.	Captain G. C. WILLIAMS, R.E.
Deputy Director of Surveys, Cadastral Branch.	Mr. A. E. TOWNSEND.
Assistant Director of Surveys, Trigonometrical and Topographical Branch.	Lieutenant A. M. COODE, R.E.
Assistant Director of Surveys, Cadastral Branch.	Mr. T. H. GALBRAITH.

EXISTING STATE OF TOPOGRAPHY.

The state of the field work and publication will be seen on the diagram attached.

THE WORK OF THE PAST YEAR.

(A.) *Trigonometrical and Topographical Branch.*

(*a*) *Triangulation.*—A total area of 2,629 square miles was covered by triangulation, and a further area of about 3,700 square miles was covered by intersected points. The average triangular error in the 18 major triangles was 1·06 seconds, in the 23 minor triangles 3·1 seconds.

The cost of triangulation was about 19·4 shillings per square mile.

(*b*) *Topography.*—The topography completed in the field was :—

$\frac{1}{125000}$ scale ...	...	...	...	1,560	square miles.
$\frac{1}{250000}$ „ ...	...	...	...	5,390	„ „
Total ...	...	...	...	6,950	„ „

and included portions of the following sheets :—

North A 36 / *Q* *North A 36* / *R* *North A 36* / *W*

North A 36 / *X* *South B 37* / *D*

Besides this, a reconnaissance sketch on the $\frac{1}{125000}$ scale was made by Lieutenant Coode, R.E., of the Maragwet country in sheet $\frac{North\ A\ 36}{R}$.

(c) *Drawing and Compiling.*—Considerable progress was made, during the year under review, with the drawing and compiling of the provisional sheets on the $\frac{1}{250000}$ scale, and the following sheets of this series, amounting to upwards of 44,000 square miles, were sent to England for reproduction :—

$\frac{South\ A\ 37}{B}$ $\frac{South\ A\ 37}{C}$ $\frac{South\ A\ 37}{H}$ $\frac{South\ A\ 37}{I}$

$\frac{South\ A\ 37}{N}$ $\frac{South\ A\ 37}{O}$ $\frac{South\ A\ 37}{T}$ $\frac{South\ A\ 37}{U}$

Of these, sheets $\frac{South\ A\ 37}{C, I, O\ \&\ U}$ have now been published, and the remainder are well in hand, with the exception of *T*, which it is not at present intended to publish, as more than three quarters of the sheet is in German territory.

The following sheets on the scales of $\frac{1}{125000}$ and $\frac{1}{250000}$ (not provisional) have been also sent to England for reproduction :—

$\frac{1}{250000}$ $\frac{South\ A\ 37}{A, V\ \&\ W}$ and $\frac{South\ B\ 37}{D}$

$\frac{1}{125000}$ $\frac{South\ A\ 37}{A\ I}$, $\frac{South\ A\ 37}{A\ II}$ and $\frac{South\ A\ 37}{B\ III}$

Of these, all three on the larger scale are either published or in hand, and those on the smaller scale will be taken up as opportunity occurs.

(B.) *Cadastral Branch.*—There has been an increase in the staff during the year, but it is still too small to deal with its work, inasmuch as large new areas continue to be opened up to farming. For quite eight months of the year, over 50 per cent. of the vacancies had not been filled up, and the dislocation of work was consequently severe, and it was only possible to carry on by engaging temporary help. The vacancies have now been filled up, but the increase of output in the field has severely taxed the resources of the clerical staff, and, in spite of frequent overtime, they have been unable to keep abreast of the field work. It is hoped that this may soon be remedied. The arrears now amount to 1,600,000 acres, and will soon be 2,000,000 acres.

The largest surveys commenced during the year are the Uasin Gishu farms (700,000 acres), the Malindi coast lands survey and the survey of Mvita on Mombasa Island, also for coast land settlement.

Tertiary triangulation covered an area of 710,400 acres, with sides of three to five miles, permanently beaconed. The average triangular error was under seven seconds.

The following summary shows the work done by the cadastral branch in 1911–12:—

Tertiary Triangulation	710,400 acres
Topographical Survey to arrange farm plots in Njoro	50,910 „
Cadastral Surveys	579,679 „
Traverses	170,349 feet

The cost of the cadastral surveys (including coast land settlement) was 6·86 pence per acre.

Computing Office.—During the year the staff has been increased from one to four computers.

Drawing Office.—The increase of the European draughtsmen from two to six has greatly facilitated the working of this office. An increase in the photographic department is necessary, the one Indian being unable to keep pace with the work.

The use of this office as a public showroom for maps, &c., has been discontinued and a new public map office has been provided.

Considerable saving has been effected by having township plans lithographed by a local firm, there being no provision for lithography in the department.

(C.) *Special work.*—Beyond the topographical reconnaissance by Lieutenant Coode in the Maragwet district and the plane-tabling of Trans-Nzoya, with a view to laying out a farm scheme, the only special work of importance has been the commencement of a reconnaissance of the country between Kiu and Doinya Sapuk. This will show soil, water, forest, herbage, &c.

(D.) *Expenditure:*—

	Estimated. £	Expended. £
Personal emoluments	13,026	11,317
Other charges	11,780	9,657
Total	24,806	20,974

(E.) *Revenue:*—

	£
Survey fees	5,463
Sale of maps, &c.	162
Total	5,625

THE GOLD COAST.

Governor	Mr. J. J. THORBURN, C.M.G.
Director of Surveys	Captain E. F. W. LEES, R.E.
Assistant Director of Surveys...	Captain H A. L. HALL, R.E.
" " " " ...	Captain P. J. MACKESY, R.E.

ORGANISATION OF THE SURVEY DEPARTMENT.

The organization of the staff for the dry season 1911–12 was as follows :—

Headquarters	Director of Surveys. Clerk.
Trigonometrical and Topographical Branch.	Assistant Director of Surveys. 2 European Surveyors.
Cadastral Branch	Chief Surveyor. 5 European Surveyors. 3 Native Surveyors.
Wallis Company Surveys ...	Assistant Director of Surveys. 10 European Surveyors.
Water Supply and Drainage Schemes Branch.	4 European Surveyors.
Drawing Office	3 European Draughtsmen. 1 Native Draughtsman.

The health of the staff, when employed in the field, has been good, the percentage of days sick being small : as in previous years, however, this percentage rose to a considerable figure when the men were employed on Town Surveys and the highest sick rate has been amongst the staff of the Water Supply and Drainage Schemes Branch.

EXISTING STATE OF TOPOGRAPHY.

Practically the whole of the Colony south of latitude 7° N. has been topographically surveyed, the framework being theodolite traverses. The sheets embracing this area have been published on the scale of $\frac{1}{250000}$. Besides these there are a few sheets on the $\frac{1}{250000}$ scale covering work done on the International Boundary Commissions.

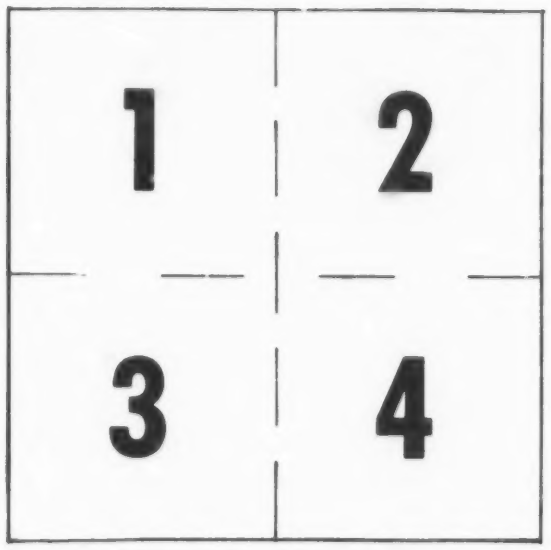
THE WORK OF THE PAST YEAR.

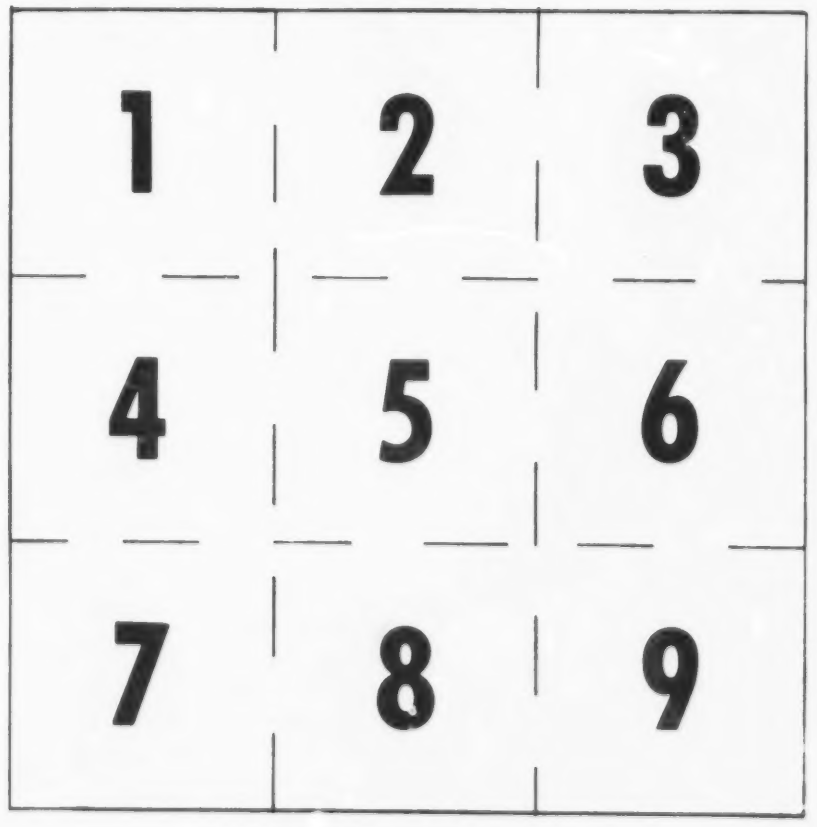
(A.) *Trigonometrical and Topographical Branch.*

(*a*) *Triangulation.*—None was executed.

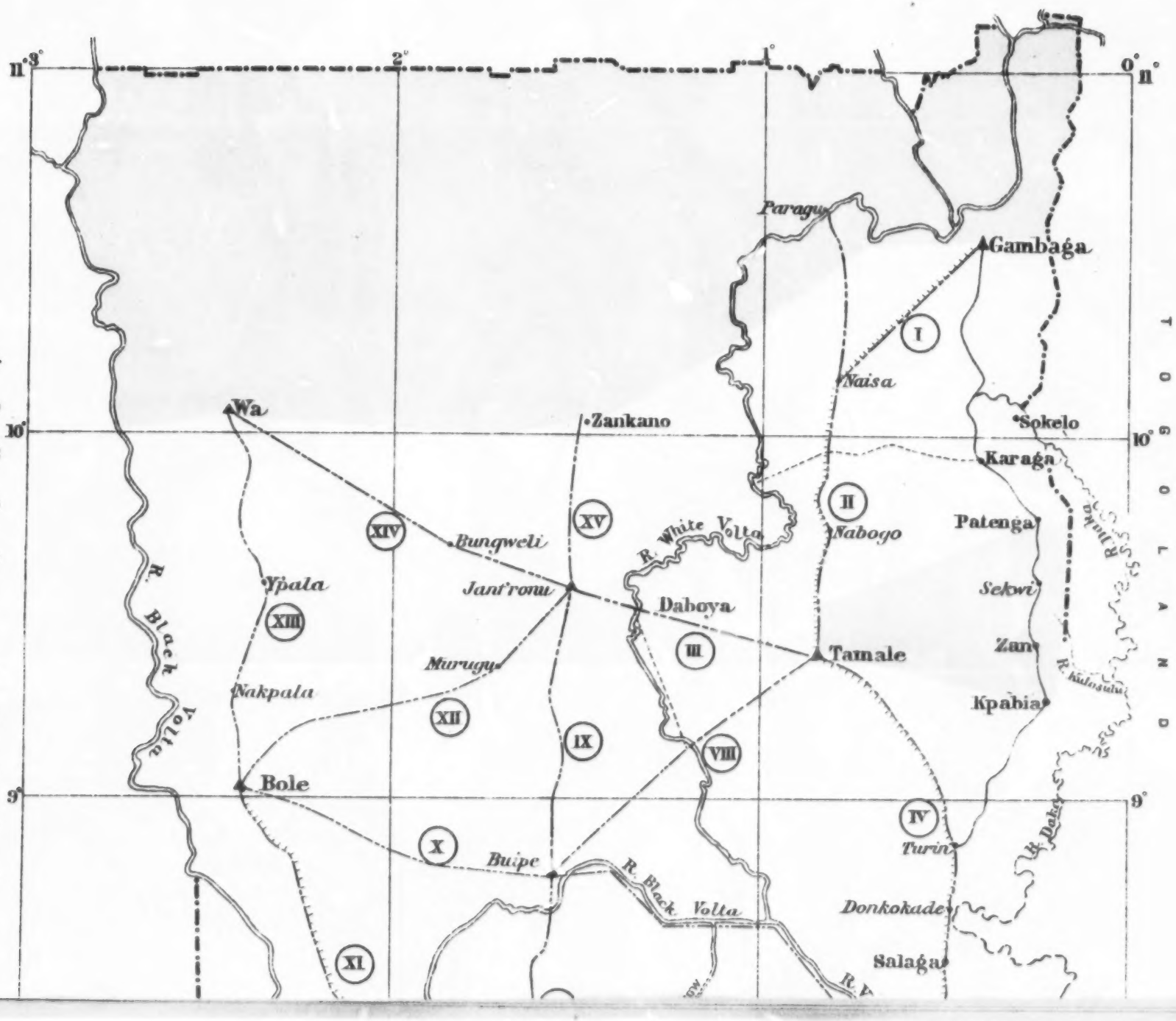
(*b*) *Topographical work.*—The survey of the Northern Territories of the Gold Coast—an area of some 31,000 square miles—having been approved, arrangements were made during the summer of 1911 to form the nucleus of a special party to carry out this work. This consisted of Captain Hall and 2 surveyors and will be expanded to 2 officers and 6 surveyors in 1912–13. Captain Hall and his party arrived in the Northern Territories about the beginning of

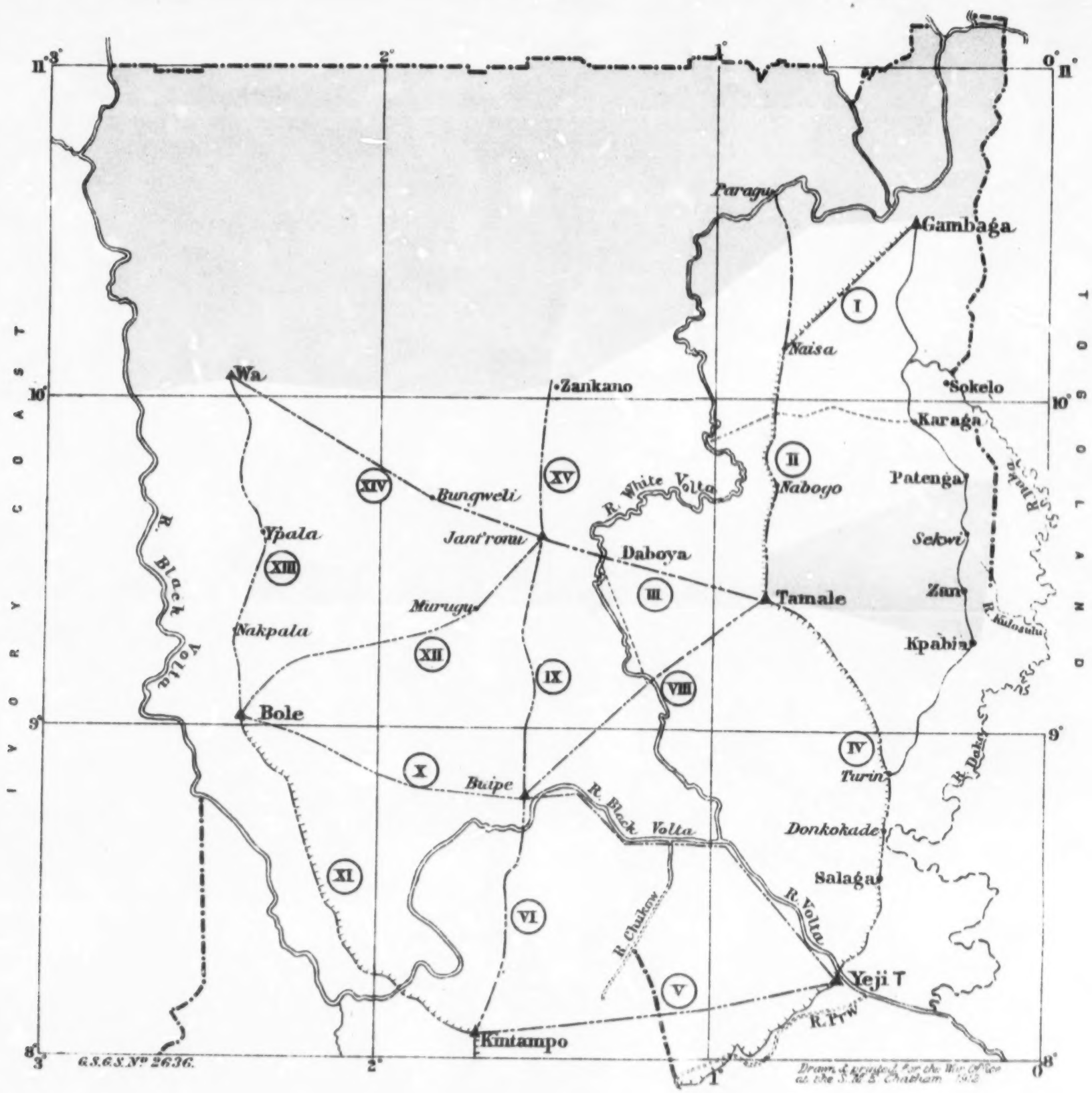
Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





SKETCH PLAN
OF
NORTHERN TERRITORIES
(To illustrate Topographical Survey Scheme)





Scale $\frac{1}{2,000,000}$ or 1 inch = 31·56 Miles

Miles 20 10 0 20 40 60 80 100 120 140 Miles

Reference

- Area to be triangulated
- Proposed rigid traverse
- Telegraph
- Astronomical Stations

November 1911 and by the end of March 1912 the following work was completed in the field :—

(1) 15 Trigonometrical stations selected.
(2) Site of Base line selected near Zouaragou.
(3) 292 miles of precise levelling completed.
(4) 148 miles of rigid Theodolite Traverse completed.
(5) 175 miles of Compass Traverse completed.
(6) The latitudes of *Gambaga* and *Tamale* determined.
(7) Sketch map of *Gambaga* and *Tamale* and their environs, on a scale of $\frac{1}{10000}$ completed.

Besides this Captain Hall was able to satisfy himself that south of a line *Gambaga—Wa*, triangulation is impossible except at a prohibitive cost. This coincides with the opinions formed by officers employed on Boundary Commissions in this district.

The general scheme for conducting the future of this topographical work is to break up the country into big blocks by means of rigid Theodolite Traverses, working these up to the Triangulation area in the North of the Colony. The conditions which it is intended should be fulfilled in the final topographical sheets, which will be degree sheets published on the $\frac{1}{250000}$ scale, are as follows :—

(1) All villages to be shewn and their positions accurately fixed.
(2) All roads and paths connecting villages to be shewn accurately.
(3) All large watercourses to be shewn accurately and the smaller ones to be accurate where crossed by roads and also shewn correctly in relation to other detail.
(4) Marshes, cultivation, forest, scrub, &c., to be shewn conventionally.
(5) Hill features to be shewn by form lines at approximately 100 feet interval.

Captain Hall calculates that after a little practice the average daily output will be from 8 to 12 square miles per diem, and at this rate the whole of the Northern Territories would be finished in a little over two years.

The index diagram attached shews the position of the primary traverse lines and of the area where triangulation is considered feasible.

Captain Hall's scheme appears to the Committee to be a suitable one.

Besides the work in the Northern Territories two areas of 300 and 145 square miles were topographically surveyed in connection with the Concessions surveys.

(C.) *Cadastral work.*—This may be considered under four headings :—

(1) Concession Surveys by the ordinary staff of the Department.
(2) Concession Surveys by special parties.
(3) Town Surveys.
(4) Water Supply and Drainage Surveys.

These will be taken seriatim :—

(1) During the past year this branch dealt with 48 concessions :—

18 were drawn, the field work having been done during the previous year.
4, already commenced, were finished.
4, which were cut by licensed surveyors, were checked.
10 were commenced and completed.
12 were commenced and are still in hand, the field work of seven being complete.

(2) In this branch the progress was very satisfactory. In all 31 Concessions were dealt with, 26 miles of the River Prah were surveyed, 15 miles of the Kwahu Kotoku Boundary was cut and 300 square miles of country mapped.

(3) The following town survey have been undertaken and successfully completed :—

Tarquah	12	sheets	on the scale of	$\frac{1}{1000}$.
	1	sheet	"	"	$\frac{1}{1500}$.
Dunkwa	8	sheets	"	"	$\frac{1}{1500}$
Saltpond	6	"	"	"	$\frac{1}{1000}$.
Winnebah	6	"	"	"	$\frac{1}{1000}$.
Kibbi	4	"	"	"	$\frac{1}{1000}$.

In addition the proofs of the sheets of Accra have been received and corrected.

Two wall maps of Seccondee on the $\frac{1}{1250}$ scale have been prepared and "K" hill has been surveyed.

At Coomassie, the survey levels have been completed, and a $\frac{1}{1500}$ plan of the town prepared. The township leases are being demarcated by a native surveyor.

(4) The ground lying between the special reservoir site and the dam site at Seccondee has been contoured.

A survey of the pipe line from the reservoir at Accra, involving $9\frac{3}{4}$ miles of levelling and 488 cross sections, has been finished.

Surveys have also been made at Seccondee and Accra in connection with land to be acquired at these places.

(D.) *Special work.*

(*a*) In connection with a serious discrepancy in the longitude of Lome as determined from Addah and that calculated from absolute methods made at several stations in Togoland, Captain Schlenzka, of the German Imperial Navy, attempted to determine the difference in longitude between Lome and Accra by transportation of chronometers. The results have not yet been received from the German Government.

At the same time it was considered desirable to check the longitude of Addah with reference to Accra, and this was done by theodolite traverse in August and September with the following result :—

Longitude at Addah = 0°, 37′, 22″. 2 E. of Greenwich.

The value determined, by the same method, by Major Guggisberg was :—

0°, 37′, 17″. 1 E.

(*b*) Map of Northern Ashanti. At present this map is not making much progresss, as only one native draughtsman is available to assist the Intelligence Officer at Coomassie; it is hoped, however, to extend the survey of the northern territories to embrace all the territory north of the 8th parallel.

(*c*) A commencement has been made with the proposed map of the Tarquah Mining District on the $\frac{1}{5000}$ scale. The map will be in four sheets.

NORTHERN NIGERIA.

Governor ... . Sir H. Hesketh Bell, K.C.M.G.
Intelligence Officer ... Captain H. Gwynne Howell, R.A.
Chief Surveyor ... ... Mr. A. Sydney Collard.

(i.) Staff.

Headquarters.

Chief Surveyor.
1 Cartographer, R.E., N.C.O.
1 Native Cartographer.
1 Native Draughtsman (vacant).

Mines Survey.

1 Surveyor lent from Political Department.
2 Surveyors, R.E., N.C.O.'s.

(ii.) Existing State of Topography.

The provisional sheets on the $\frac{1}{250000}$ scale, covering the whole country, have all been published with the exception of three sheets. Except along the international boundaries, where the work was of a good secondary character, the whole of the topography is compiled from route sketches adjusted to the position of 13 towns fixed in latitude and longitude by Captains Ommanney and Evans.

(iii.) Work of the Past Year.

(*a*) Captain H. N. Kempthorne was appointed Assistant Director of Surveys, East Africa Protectorate, and left Northern Nigeria on the 28th September, 1911. Mr. Gregson Williams, lent from the Political Department, took over from Captain Kempthorne and Mr. A. Sydney Collard was appointed Chief Surveyor on December 16th, 1911.

(*b*) Up to the time Captain Kempthorne left for East Africa, a field party, consisting of the Chief Surveyor and two N.C.O.'s, R.E., was working on a $\frac{1}{62500}$ scale map of the Bauchi Tin Mine area.

One sheet was completed and three more are in hand. Much interruption with the proper progress of the survey was experienced and accounts for the slow progress made. The rains in June and July were exceptionally heavy and delayed work, and on the 10th of June Mr. Langslow Cock, the Government Inspector of Mines, was invalided, and Captain Kempthorne was instructed by His Excellency the Governor to take over the Government Inspector of Mines' duties as well as his own.

(*c*) Soon after Captain Kempthorne left it was decided to use the whole Survey Staff in checking and inspecting mining leases and prospecting areas, and Mr. Gregson Williams and the two R.E. corporals remained on this duty until the end of the year.

(*d*) Mr. A. S. Collard immediately on his transfer was sent down to Akwana and Arufu to check mining areas in dispute; he afterwards went up to Naraguta to visit the field party and give evidence before the Advisory Committee, and he was in Naraguta for this purpose until the end of the year under review.

(*e*) It is hoped to re-organise the Department during the next year and to start both topographical and cadastral branches.

SOUTHERN NIGERIA.

Governor	... ...	Sir WALTER EGERTON, K.C.M.G.
Director of Surveys	... ...	Major F. G. GUGGISBERG, C.M.G., R.E.
Intelligence Officer	... ...	Captain W. H. BEVERLEY, Essex R.

(i.) STAFF.

Headquarters.

Director of Surveys.
Office Superintendent.
Chief Assistant.
4 Clerks.
2 Photographers.
1 Map Curator.

Cadastral Branch.

Deputy Director of Surveys.
2 European Surveyors.
4 Native Surveyors.
4 „ Draughtsmen.
1 Clerk.

Topographical Branch.

1 Deputy Director.
3 Assistant Directors.
10 European Surveyors.
11 Native Surveyors.
5 „ Draughtsmen.

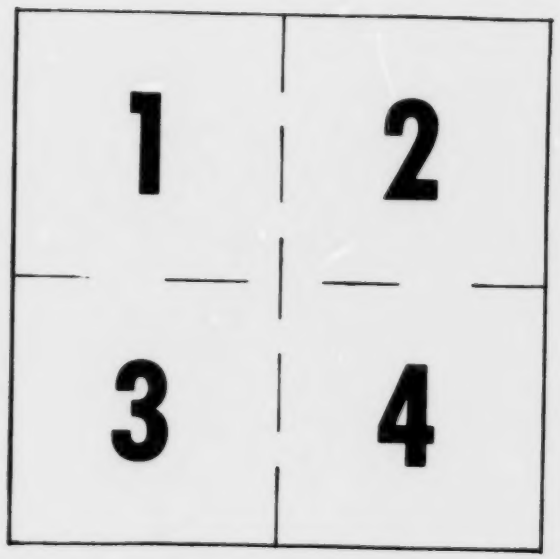
Special Cadastral Party.

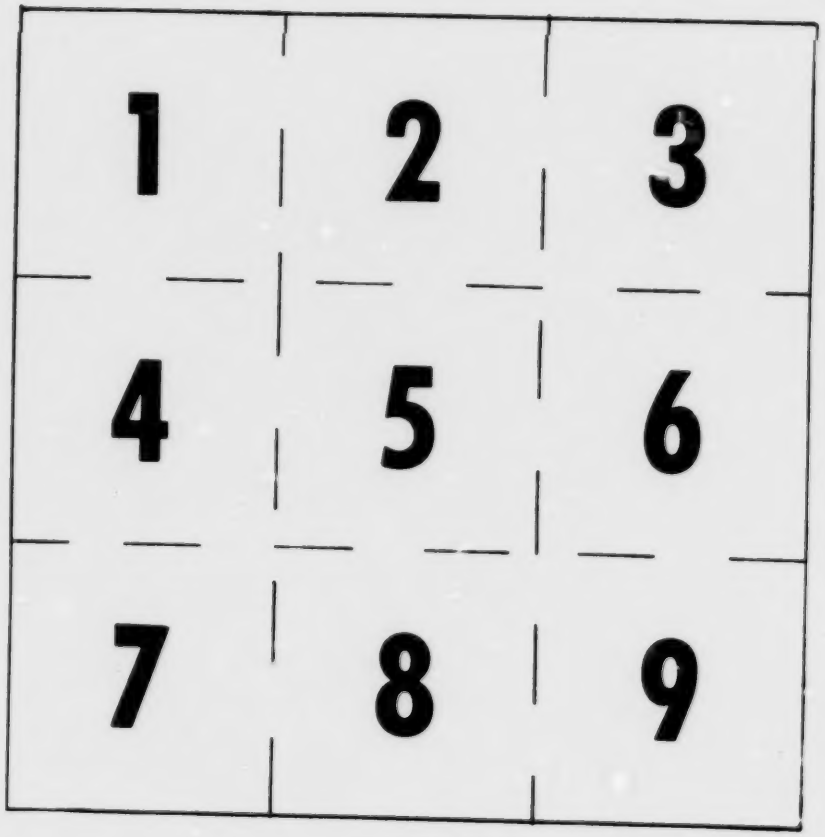
1 European Superintendent.
12 „ Surveyors.

School and Meteorological.

1 Chief Instructor.
9 Meteorological Clerks
21 Pupils.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





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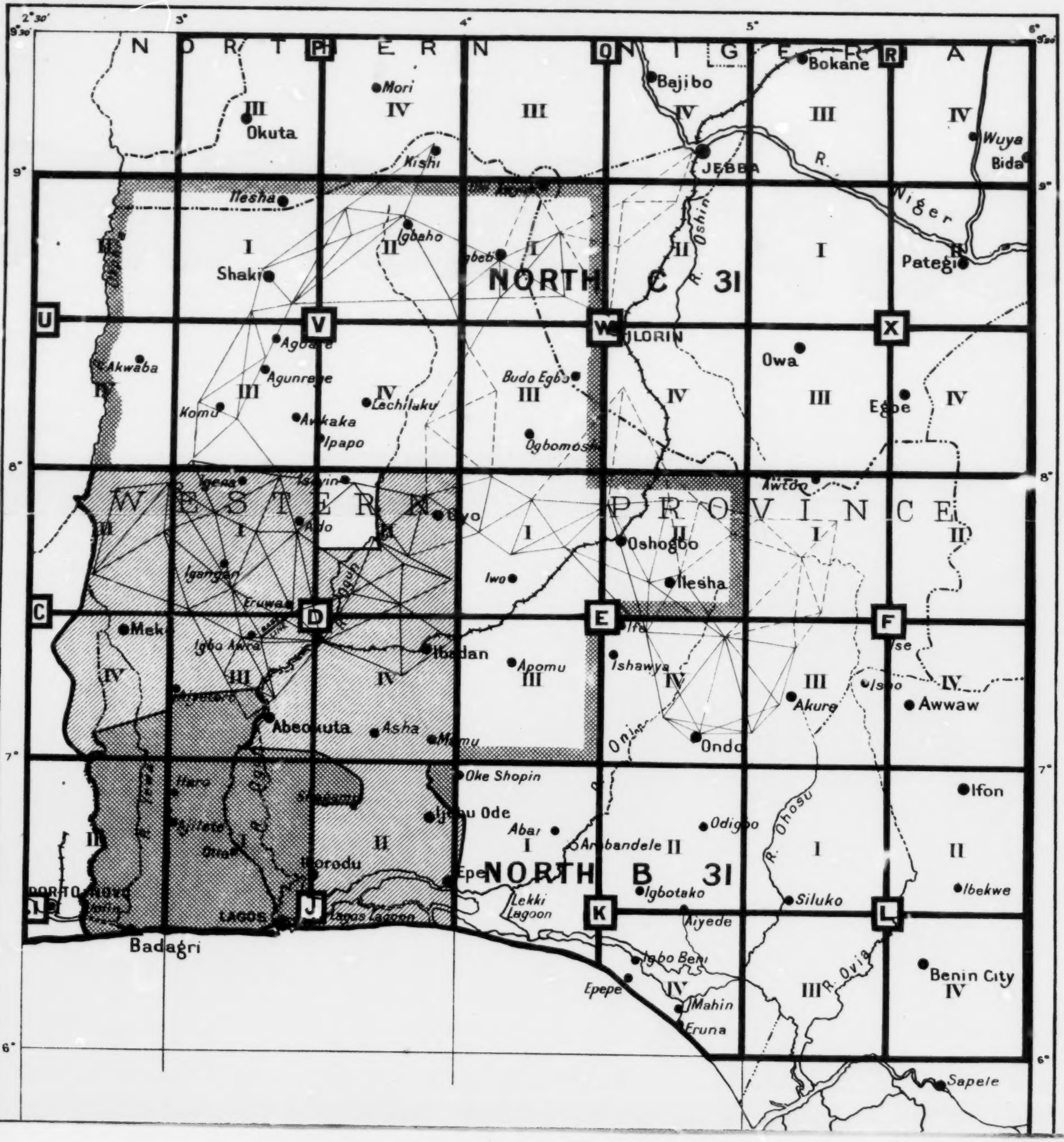
MAP FOR ANNUAL REPORT OF SOUTHERN NIGERIA SURVEY 1911-12



INDEX
TO THE
1:125,000 SURVEY
OF
SOUTHERN NIGERIA.

Scale 1/2,000,000 or 1·014 Inches to 32 Miles.

Miles 50 40 30 20 10 0 50 Miles

Explanation

- Area covered by previous Triangulation
- Area covered by Triangulation 1911 - 1912
- Area beaconed for 1912 - 1913
- Area previously surveyed
- Area completely Topographically surveyed 1910, 1911
- Area to be completed 1911 - 1912
- Standard sheets to be published on scale of 1:125,000
- Boundary International
- Boundary Intercolonial
- Railways

From information furnished by
Major F. G. Guggisberg C.M.G. R.E.
Director of Surveys.

Geographical Section, General Staff No 2583.

War Office July 1912.

An average of 33 per cent. of each European's services was lost through leave, sickness, or delayed appointment. There was an unusual amount of sickness, four Europeans being invalided. The Topographical Branch lost nearly 240 man-days' work from sickness and the Special Cadastral Party about 25 per cent. of their time.

(ii.) The Work of the Past Year.

(a) *Changes in organisation.*—Provincial Lands Survey Sections were introduced with headquarters at Warri and Calabar respectively, with the object of carrying out the surveys of the more important towns in the provinces and the numerous lands surveys required by the Government.

Finance Regulations and Stores Regulations, both based on the official regulations in force in the Colony, were added to the books governing the department. The "Handbook of the Southern Nigeria Survey and Text Book of Topographical Surveying in Tropical Africa," containing the alterations found necessary during its test in cyclostyle form during the first field season, was published in August, 1911. "Topographical Branch Memos." and "Cadastral Branch Memos." were introduced with the object of issuing and preserving in cyclostyle form the orders of the officers in charge of the respective branches for the technical execution of work.

Work of the Trigonometrical Section, Topographical Branch.

(*b*) Observations were taken from 33 main stations, 47 minor stations and six auxiliary stations; 92 intersected points were fixed. The total area covered by triangulation was 5,577 square miles at a cost, including reconnaissance and beaconing, of 7*s.* 10*d.* per square mile, as against last season's record of 4,640 square miles at 9*s.* 10*d.* The average error in the main triangles was 4·33″ and in the minor triangles 8·8″, as against the 5·9″ and 11·5″ of last season's work. The trigonometrical signals were in practically all cases heliographs, heliostats and lamps.

The actual observations were practically carried out entirely by Lieut. G. G. Waterhouse, R.E., with the assistance in the minor triangulation of 2nd Corporal Hosking, R.E. In addition to the work given above, 20 points were beaconed for the work of next season, and points selected by plane-table reconnaissance covering about 1,600 square miles.

(*c*) Work of the Topographical Section.

During the field recess of 1911 the Director and the Deputy Director of the Topographical Branch were continuously employed in the London office in the completion of field sheets for publication, engaging additional staff, preparation of outfit, stores, and programme for the coming season. Each member of the staff assisted

in the office for a month or six weeks. Index charts and conventional sign plates were prepared for publication, the proofs of the handbook corrected, and a card index of over 5,000 place names started.

During the same period instructional field camps of young native surveyors were employed in the field under the charge of senior native surveyors; 100 miles of instrumental levels were run, and about 250 square miles of forest country completely surveyed.

The instrumental levels cost £1 0*s.* 11*d.* per mile and closed to 4 inches on the main triangulation.

The Topographical Branch embarked for Lagos on September 20th and took the field before October 10th.

Seven ½° sheets were undertaken, of which six were fully completed. The seventh sheet was three-fourths completed. The surveys were carried from a ¼ mile to a mile into the adjacent sheets. The following was the total output, the figures for the preceding season being given in brackets:—

i. Country completely surveyed, including form lines, 5,598 (2,579) square miles at £1 9*s.* 1*d.* (£1 12*s.* 8½*d.*) per square mile. Of this area only about 200 square miles was plane-table country.
ii. Miles of compass traverse involved in the above survey, 11,713 (4,978) at 15*s.* 1*d.* (£1 3*s.* 6*d.*) per mile.
iii. Miles of theodolite traverse, 192 (237).
iv. Miles of instrumental levels, 101 (241).
v. Number of beacons erected, 452 (432).
vi. Standard ½° sheets sent to publisher, 6 (2).

The improvement in results is remarkable in view of the serious delays that were caused by the necessity of re-survey of nearly 200 miles of old theodolite traverse temporarily accepted as part of the framework, by the employment of several field camps on the French frontier demarcation, and by the invaliding of three Europeans. The improvement is chiefly due to greater experience in topographical methods and to the employment of more native surveyors.

The performances of two field camps call for special comment. No. 1 (2nd Corporal T. W. Pedley, R.E.), 834 square miles at 16*s.* 9*d.*, 1,478 traverse miles at 9*s.* 6*d.* No. 2 (Lance-Corporal R. Sarson, R.E.), 630 square miles at £1 2*s.* 3*d.*, 2,058 traverse miles at 6*s.* 9*d.* Each N.C.O. had two native surveyors with him. The best performance of a native surveyor was A. O. Craig's 780 miles, J. B. Cole being second with 769.

(*e*) Work of the Cadastral Branch.

The most important work of the year was the detail survey of Lagos to enable the long outstanding location of titles to be taken in hand seriously by a Commission to be appointed probably in 1914. The survey was undertaken by a Special Cadastral Party a Superintendent, and 12 N.C.O.'s, R.E.; the party landed on September 1st, 1911; owing to the difficulty of finding suitable quarters during—and to the delay caused by—the rains, the majority

of the party returned to England on June 13th, sufficient being left to complete six sheets of the 88-foot ($\frac{1}{1056}$) map for publication. The survey was based on a primary theodolite traverse surrounding the town; the area enclosed was divided into blocks by secondary traverses, and again into sections by tertiary traverses. Each section was completely surveyed, drafted on a scale of 30 links, and examined in the field. Cement blocks were sunk at every station on the traverses. One 88-foot sheet was completely drafted as a guide to the publishers and the framework plotted on the others with a view to the section plans being reduced and compiled on the 88-foot sheets in England.

Base lines were cut and surveyed on the Ikazi Plains, titles located, a street scheme for the future expansion of Lagos drawn up, and four sheets of the 88-foot map completed and written up.

The work of the permanent Cadastral Branch was limited to keeping pace with the demands of Government for appropriations, reclamations, encroachments, street lines, wharf extensions, and the location of the more pressing titles. Owing to the rapid development of Lagos, the above-mentioned demands were greater than the strength of the staff available was able to cope with satisfactorily, but in spite of this useful progress was made in surveying the framework and a certain amount of detail on, and in drafting, the 35 sheets of the 88-foot map covering Ebute-Metta, Apapa, and Iddo. As only one European of the permanent Cadastral Staff was available, it was necessary to obtain assistance from the Special Party in order to cope with current work.

In the Eastern Province the town survey of Calabar was continued, and useful progress made with lands surveys, but the demand for these was out of all proportion to the strength of the staff available.

(*f*) Work of the School and Meteorological Branch.

The chief work of the school was the education of the junior class joining in October, 1911, and in bringing up to date during the field recess the higher education of the senior and middle classes, which were employed with the field camps during the field season. The class of candidate for admission is improving and excellent results are being obtained. In addition to his scholastic duties, the Chief Instructor supervised the observations at, and the compilation of returns from, 35 meteorological installations in the Colony.

(*g*) Special Work.

An International (local) Boundary Commission located and marked with 142 cement pillars the Southern Nigeria-Dahomey frontier between the Gulf of Guinea and the Okpara River. The British section worked under the Director of Surveys as Chief Commissioner (local) and consisted of the field camps of No. 1

group, topographical section. A complete topographical map ($\frac{1}{100000}$) of the frontier zone was drafted, and a satisfactory connection effected between the topographical maps of Dahomey and Southern Nigeria.

The longitudes of the beach pillar, fixed by theodolite traverses from Cotonou and Lagos, themselves fixed respectively by cable from Brest and Capetown, agreed to within one second of arc.

The boundaries of the Abeokuta District (Egba Kingdom) and of six forest reserves were surveyed and marked by the Topographical Section, and special coloured plans for the water supply of Ibadan and for motor roads, supplied to the Government.

A large and variable amount of local attraction was discovered after careful circum-meridian observations for latitude at certain points on the trigonometrical and theodolite traverse framework. Pressure of work prevented complete investigation, but the results obtained proved the general unreliability of observed latitudes in Southern Nigeria as checks on theodolite traverses. In three cases the error proved to be over 10 seconds. Fuller investigation will be made next season into this question and also into that of the aneroid readings with which considerable trouble was experienced during the harmattan.

(*h*) Maps Published.

The delays incidental to, and the care required in, the publication of the first sheet of a new series of maps prevented the actual publication of any standard ($\frac{1}{2}°$) sheet. The final proofs of the Badagri sheet were passed, conventional sign sheets for the field sheet ($\frac{1}{62500}$) and standard sheet ($\frac{1}{125000}$) scales published. The publishers have now in hand eight $\frac{1}{2}°$ sheets of the standard map and six sheets and a conventional sign plate of the Lagos map. Topographical plans ($\frac{1}{12500}$) of Ibadan, Abeokuta, Oyo, and Lagos are also in hand.

By arrangement between the Survey Department and the Intelligence Officer, the latter compiled a general map of the Western Province ($\frac{1}{500000}$), which supplies a long-felt want pending the publication of the standard map. The Intelligence Officer also produced a very useful school wall map of the Colony. Both maps were published by Stanford's.

(*i*) Expenditure.

The total cost of the department for the period under review was £22,927, of which £13,986 was spent on the topographical survey, and about £5,000 was non-recurrent expenditure on the special Lagos survey. An illustration of the conditions under which West African surveys are executed is furnished by the fact that passages and salaries during leave and sickness add 33 per cent. to the actual working expenses of survey.

(*j*) General Remarks.

The satisfactory result of the work of the Topographical Section by which over double the area surveyed during the

previous year was completed with a reduction in cost of 3*s.* 7½*d.* per square mile, and this under exceptionally unfavourable conditions, reflects much credit on this branch. The output, cost, and technical accuracy of the work of the Trigonometrical Section is also satisfactory. In short, the Committee consider that Major Guggisberg and his staff are to be congratulated on the results obtained during the year under review.

NYASALAND.

Governor ... ... Colonel Sir W. H. MANNING, K.C.M.G., C.B.
Director of Public Works ... Mr. T. I. BINNIE.
(The Public Works Department undertakes the surveys.)

(i.) EXISTING STATE OF TOPOGRAPHY.

No systematic topographical survey exists. Eleven sheets, on the $\frac{1}{250000}$ scale, were published in 1901–04, based on route sketches, and in 1908 a revised map on the $\frac{1}{1000000}$ scale was issued.

WORK OF THE PAST YEAR.

During 1911–12 the Assistant Director of Public Works was engaged for five months in erecting permanent beacons along the Anglo-Portuguese frontier from close to Port Maguire to Mlanje.

During this period a trigonometrical survey was made of the boundary.

Mr. Bannerman, the Assistant-Surveyor, has during the year surveyed 18 estates in the Mlanje, Ruo, and Blantyre Districts which have been bought or leased from the Crown. The total area involved was 22,519 acres. These estate surveys were made with a 5-inch transit theodolite and the distances chained. The work is now being plotted.

PEMBA ISLAND.

Staff.

Captain J. E. E. Craster, R.E.
Lieutenant W. F. R. Kyngdon, R.A.
Lance-Corporal E. W. F. Cager, R.E.
Lance-Corporal W. J. Whitters, R.E.
Lance-Corporal F. S. McQueen, R.E.

Major Gordon, R.E., visited the island during 1910, and selected positions for a base, and for several trigonometrical points. His work saved the survey party a good deal of time that would otherwise have been spent in reconnaissance.

The survey party arrived in Pemba at the end of May, 1911.

A base, 2·6 miles long, was measured on the eastern shore of Fundu Island, which lies some two miles to the west of the main island. The central portion of the base lies below low-water mark, and the measurement of this portion had to be carried out in a depth of two feet of water. A 300-foot steel tape was used. The base was measured twice, with a probable error in measurement of 0·4 inches.

Points were fixed by triangulation along the western shore, and on the islands lying off it. No triangulation was possible inland owing to the dense clove plantations and bush, and the lack of any prominent hills.

Five theodolite traverses were run from west to east across the island, to provide points for the topographers. The heavy compensation that had to be paid for cutting clove trees prevented much clearing being done, and the work was a good deal hampered in consequence.

The whole of the topographical work was done by means of compass traverses, no other method being practicable, owing to the dense bush and clove plantations. Closing errors were distributed along the traverses.

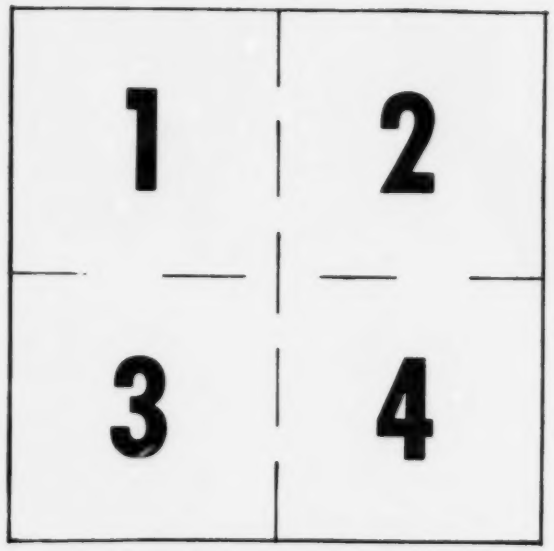
The progress made by the topographers was very slow, owing to the large amount of detail, and the very complex nature of the topographical features. Much time was lost through wet weather. The survey of the island was finished by the end of February, 1912, the area mapped amounting to 380 square miles.

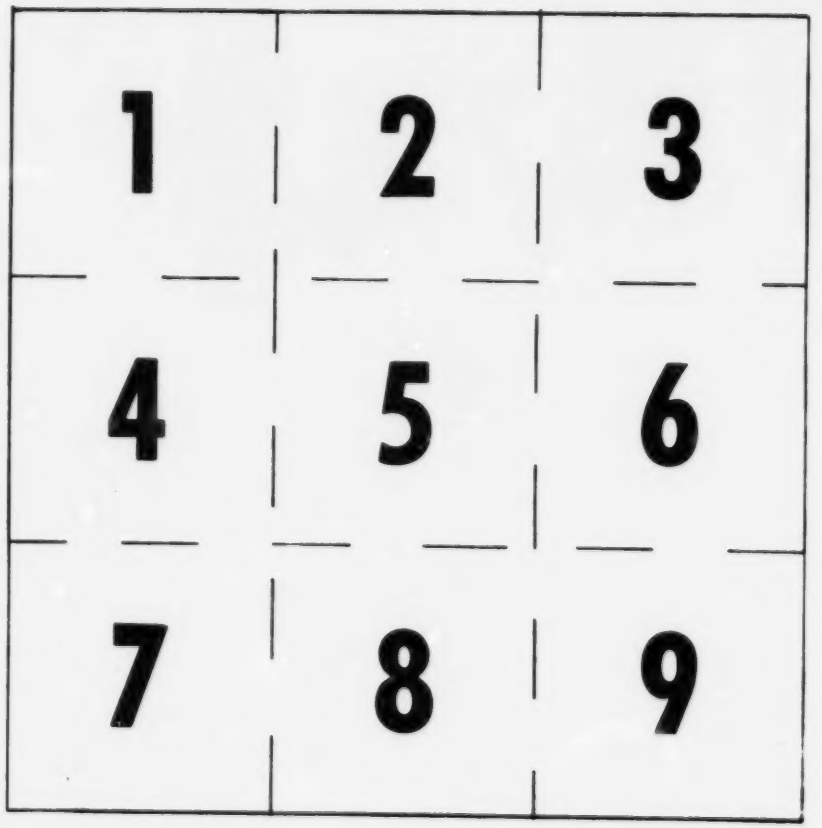
The island has always been considered to be very unhealthy, and the survey party were the first Europeans who had ever attempted to camp for more than a few nights in the interior. All the party suffered from malaria, but otherwise their health was better than might have been expected.

The field sheets are now being reproduced on the scale of one inch to one mile.

Captain Craster and his party have carried out a difficult survey in a satisfactory manner.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





INDEX

to the sheets of

SOUTH AFRICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

Miles 50 0 50 100 150 300 Miles

REFERENCE

Field sheets completed

Sheets published

Red names shew names of sheets

BECHUANALAND

GERMAN SOUTH WEST AFRICA

ORANGE FREE STATE

TRANSVAAL

BASUTOLAND

SOUTH-F-35

SOUTH-G-35

SOUTH-H-33

SOUTH-H-34

SOUTH-H-35

RHODES' DRIFT

ZOUTPANSBERG

Palapye

MAGALAKWYN

N. PONGOLA FLATS

BLAAUWBERG

PIETERSBURG

Marabastad

Pietersburg Road

Louis Trichardt

Messina

Gaberones

Mochudi

DERDEPOORT

KRANTZBERG

PILGRIMS REST

GELUK

ZEERUST

RUSTENBURG

PRETORIA

MIDDELBURG

MAFEKING

Lichtenburg

JOHANNESBURG

MARIBOGO

Geysdorp

KLERKSDORP

PUTCHEFSTROOM

Vereeniging

Vryburg

WOLMARANSSTAD

WREDEFORT

FRANKFORT

HEILBRON

VREDE

BLOEMHOF

KROONSTAD

LINDLEY

HOOPSTAD

BETHLEHEM

HARRISMITH

WINBURG

SENEKAL

FICKSBURG

BOSHOF

KIMBERLEY

LADYBRAND

BLOEMFONTEIN

THABANCHU

EDENBURG

WEPENER

HOPETOWN

PHILIPPOLIS

SMITHFIELD

BETHULIE

ROUXVILLE

PHILIPSTOWN

VANWYKSVLEI

DE JUIN

KAKAMAS

KHEIS

GRIQUATOWN

DOUGLAS

PRIESKA

KENHARDT

UPINGTON

PELLA

SCUIT DRIFT

WARMBAD

LITTLE BUSHMAN LAND

ORANGE RIVER MOUTH

STINKFONTEIN

OOKIEP

PORT NOLLOTH

Ladysmith

Dundee

Newcastle

Weston

Bulwer

Richmond

Clydesdale

Colenso

Weenen

Orange R.

Limpopo R.

Vaal R.

Modder R.

Riet R.

Caledon R.

Tugela R.

Buffalo R.

Klip R.

INDEX

to the sheets of

ICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

0 50 100 150 200 Miles

REFERENCE

Field sheets completed

Sheets published

Red names shew names of sheets

SOUTH-F-35

SOUTH-F-36

SOUTH-G-35

SOUTH-G-36

SOUTH-H-34

SOUTH-H-35

SOUTH-H-36

TRANSVAAL

ORANGE FREE STATE

BECHUANALAND

PORTUGUESE EAST AFRICA

SWAZILAND

BASUTOLAND

NATAL

ZULULAND

RHODES' DRIFT

ZOUTPANSBERG

PAFURI

LETABA

PIETERSBURG

LEYDSDORP

UMBABAT

OHRIGSTAD

GELUK

DERDEPOORT

KRANTZBERG

PYLSTROOM

MAGALAKWYN

N. PONGOLA FLATS

BLAAUWBERG

MARIBOGO

KLERKSDORP

POTCHEFSTROOM

JOHANNESBURG

PRETORIA

RUSTENBURG

ZEERUST

MAFEKING

MIDDELBURG

MACHADODORP

KOMATI POORT

AMSTERDAM

BREMERSDORP

STANDERTON

WAKKERSTROOM

UTRECHT

VREDE

FRANKFORT

HEILBRON

KROONSTAD

LINDLEY

HOOPSTAD

WREDEFORT

BLOEMHOF

VRYBURG

WARMBAD

SCUIT DRIFT

KAKAMAS

UPINGTON

KHEIS

GRIQUATOWN

DOUGLAS

KIMBERLEY

PELLA

KENHARDT

PRIESKA

DE JUIN

LITTLE BUSHMAN LAND

HOPETOWN

VANWYKSVLEI

PHILIPSTOWN

BOSHOF

WINBURG

SENEKAL

FICKSBURG

LADYBRAND

BLOEMFONTEIN

THABANCHU

EDENBURG

WEPENER

SMITHFIELD

PHILIPPOLIS

BETHULIE

ROUXVILLE

HARRISMITH

BETHLEHEM

BORKENSDRIFT

LADYSMITH

DUNDEE

NEWCASTLE

GREYTOWN

STANGER

PIETERMARITZBURG

DURBAN

RICHMOND

WESTON

CLYDESDALE

SCOTTSBURG

NDWANDWE

USUTU RIVER MOUTH

ST LUCIA BAY

LAND

ENTONJANENI

SOUTH-H-33

SOUTH-H-34

SOUTH-H-35

SOUTH-I-34

SOUTH-I-35

ATLANTIC OCEAN

INDIAN OCEAN

CAPE OF GOOD HOPE

ORANGE RIVER MOUNTH

STINKFONTEIN

WARMBAD

SCUIT DRIFT

KAKAMAS

KHEIS

GRIQUATOWN

KIMBERLEY

BOSHOF

WINBURG

SENEKAL

FICKSBURG

LADYBRAND

BLOEMFONTEIN

THABANCHU

HOPETOWN

DOUGLAS

PRIESKA

KENHARDT

PELLA

DE TUIN

LITTLE BUSHMAN LAND

OOKIEP

PORT NOLLOTH

BOWESDORP

KAMIESBERG

LORIESFONTEIN

BRANDVLEI

VAN WYKS VLEI

CARNARVON

BRITSTOWN

PHILIPPOLIS

PHILIPSTOWN

EDENBURG

WEPENER

SMITHFIELD

BETHULIE

ROUXVILLE

ZASTRON

MOUNT FLETCHER

S.W.

S.E.

N.W.

N.E.

BASUTOLAND

NATAL

Ladysmith

Colenso

Weenen

Weston

Bulwer

Richmond

P'MARITZBURG

KOKSTAD

Clydesdale

Smarts Town

PORT SHEPSTONE

PONDOLAND

Port St Johns

Mount Ayliff

Harding

Jamestown

Burghersdorp

Stormberg

Slang River

Lady Frere

Queenstown

Tarkastad

Molteno

Rosmead

Steynsburg

Moraisburg

STERKSTROOM

UMTATA

Clarkebury

Whittlesea

GREAT WINTER BERG

STUTTERHEIM

BUTTERWORTH

Bedford

Alice

Fort Beaufort

Willowvale

East London

GRAHAMSTOWN

Alicedale Jct.

Bathurst

Port Alfred

Alexandria

UITENHAGE

Algoa Bay

Port Elizabeth

C. Recife

HUMANSDORP

C. St Francis

KNYSNA

GEORGE

Mossel Bay

Riversdale

Swellendam

Caledon

Bredasdorp

C. Agulhas

Malagas

Kaffir Kuils River

Berrydale

Riversdale

Heidelberg

Greyton

Stellenbosch

French Hoek

Simons Town

Cape of Good Hope

Hermanus

Stanford

Walker B.

Caledon

Robertson

Worcester

Ceres

Tulbagh

Bridgetown

Hopefield

Saldanha B.

Vredenburg

St Helena B.

Port Owallie

Piquetberg

Elands Kal

Clanwilliam

Cedar Berg

Sutherland

Matjesfontein

Ladismith

Calitzdorp

Prince Albert

Klaarstroom

Steytlerville

Willowmore

Wolvefontein

Oudtshoorn

Uniondale

Haarlem

Avontuur

Blanco

George

Millwood

Knysna

Humansdorp

Graaf Reinet

Aberdeen

Camdeboo

Beaufort West

Vander Byl's Kraal

Prince Albert

Gamka R.

Gouritz R.

Touw R.

Keiskamma R.

Great Kei R.

Buffalo R.

Tugela R.

Orange R.

Doorn Langte

Olifants R.

Steen Kamps Poort

Elands Kal

Harbeest Kal

Van Rhyns Dorp

Fraserburg

Doornboom

Otfants R.

Calvinia

Williston

Loxton

Victoria West

Naauwpoort

Steynsburg

Noupoort

Colesberg

De Aar

Hanover

Britstown

Carnarvon

Van Wyks Vlei

Brandvlei

Loriesfontein

Kamiesberg

Bowesdorp

Ookiep

Port Nolloth

Little Bushman Land

Pella

Kenhardt

De Tuin

Kakamas

Griquatown

Douglas

Prieska

Hopetown

Kimberley

Boshof

Winburg

Senekal

Ficksburg

Ladybrand

Bloemfontein

Thabanchu

Edenburg

Wepener

Smithfield

Philippolis

Philipstown

Bethulie

Rouxville

Zastron

Mount Fletcher

Basutoland

Natal

Pondoland

Griqualand West

Orange River Colony

Cape Colony

G. S. G. S., Nº 2214.

Compiled in the Geographical Section, General Staff.

1906

SOUTH-H-34

SOUTH-H-35

SOUTH-H-36

SOUTH-I-34

SOUTH-I-35

Compiled in the Geographical Section, General Staff.

1906

War Office, Revised July, 1912.

SOUTH AFRICA.

General State of the Military Surveys.

All the topographical surveys in South Africa are now closed down. That of the Orange Free State was completed in July, 1911, and the Transvaal manœuvre area was finished early in 1911. The reconnaissance survey of the northern portion of the Cape of Good Hope was closed down in November, 1911, and the officer in charge, Captain Hopkins, Manchester Regiment, returned to England with all the documents and material.

The map of Basutoland, on the $\frac{1}{250000}$ scale, has been published in four sheets capable of being mounted together as a wall map.

The sheets of the Cape Colony series have been steadily proceeded with, and during the past year the following have been published:—

South H. 34/B. Scuit Drift.
" " J. Kenhardt.
" " P. Van Wyk's Vlei.
" " Q. Carnarvon.
" " V. Fraserburg.
" " X. Victoria West.
" 35/Q. Mt. Fletcher.
" " S. Naauwpoort.

In the Orange Free State some trouble has been experienced in locating the farm boundaries, which were not put in on the original field sheets, but this difficulty has now been overcome, and it is hoped that the maps will be published shortly.

The diagram giving the state of the topographical surveys of South Africa shows that a large amount of work has been done. It is much to be regretted that the work has for the present ceased. It is desirable from every point of view that accurate topographical maps should exist for the whole area.

UGANDA.

Governor	Mr. F. J. Jackson, C.B., C.M.G.
Director of Surveys	Mr. R. C. Allen.
Special Topographical Survey in Ankole.	Major E. M. Jack, R.E.

(i.) Staff.

During 1911–12 the staff of the Land and Survey Department was reduced by one European draughtsman and was increased by four survey probationers, of whom, however, only two had been

appointed during the year. In March, 1912, the staff consisted of:—

Director of Surveys.	1 European Draughtsman.
14 European Surveyors.	3 Indian Clerks and Draughtsmen.
1 Indian Surveyor.	

The organization of the staff was as follows :—

At Headquarters.—Director and one assistant (usually the Deputy Director).

Survey of Crown Lands.—Two surveyors.

Cadastral Survey of Native estates.—Eight surveyors.

The Deputy Director was on leave for 10 months and two of the vacancies were unfilled.

(ii.) Existing State of Topography.

This is shewn on the Index diagram for East Africa.

(iii.) Work of the Past Year.

(*a*) *Triangulation.*—Nil.

(*b*) *Cadastral.*—The area over which theodolite observations for cadastral work were made was 1,054 square miles—more than double that of 1910–1911. The *total* area to 31st March, 1912, was 3,487 square miles.

Detail was completed over 907·56 square miles compared with 409·44 for 1910–11. The *total* area, completely surveyed to 31st March, 1912, was 3,283 square miles.

The work of this cadastral survey was divided into two parties under Mr. Boazman and Mr. E. G. Fenning, and the Director of Surveys considers that their work is worthy of special praise, as is Mr. McGregor's personal output of 263·42 square miles for the year.

This satisfactory progress is largely attributed to :—

(i) The relatively easier nature of the country. (A large stretch of grass land was met with which made surveying much easier than the usual elephant grass).

(ii) The willing assistance given by the natives in cutting boundary lines. The cost per square mile of these cadastral surveys was £5 2*s.* compared with £7 15*s.* 4*d.* last year and the £8 2*s.* of Major Hills's estimate. The reduction of the cost is explained in part by the small amount of leave which fell due in 1911–12.

In the *Crown land surveys* the total area surveyed or re-surveyed was 12,753 acres.

Town surveys.—During the year the greater part of the township of Jinja has been surveyed and a commencement has been made at Namasagali, the terminus of the Busoga Railway. A large number of plots have also been set out at Kampala and Masaka.

Satisfactory progress has been with the tracing of the field sheets in the drawing office. Including sheets still in the field the total number of sheets surveyed to date is 283, and of these 220 have been traced. 2,600 sun prints have been made during the year compared with about 1,500 in 1910–11.

(*c*) *Expenditure and Revenue.*—The estimated expenditure for 1911–12 was £9,065 while the revenue was expected to reach £5,350 The exact figures are not available, but it is hoped that the revenue will be up to expectations while the expenditure should be about £740 less.

Topographical Survey.

Advantage has been taken of the presence of the Boundary Commission in the "Mfumbiro" district to extend their work into Ankole, and a sum of £3,000 was allotted for the purpose of executing a topographical survey in this region.

The work of the Boundary Commission came to an end in August, 1911, and since then the following staff have been at work in the Western Province :—

Major E. M. Jack, R.E. (in charge).
Captain the Honourable F. R. D. Prittie, Rifle Brigade.
Serjeant A. Thomas, R.E.
Corporal G. Archer, R.E.
Lance-Corporal S. Powell, R.E.
„ F. A. Old, R.E.

Up to March, 1912 (including the topography of the Boundary Commission), 2,400 square miles have been topographically surveyed and in addition 1,200 square miles triangulated, and the whole of sheet South A. 36 G. has since been completed.

IV.

THE STATE OF THE SURVEYS

OF

BRITISH HONDURAS, CEYLON, CYPRUS, FEDERATED MALAY STATES, FIJI, JAMAICA, TRINIDAD.

BRITISH HONDURAS.

Governor ... ... Colonel Sir E. J. E. SWAYNE, K.C.M.G., C.B.

Surveyor-General ... ... Mr. H. I. PERKINS, I.S.O., F.R.G.S., F.G.S.

(i.) STAFF.

Surveyor-General.	1 Clerk.
Assistant Surveyor-General.	2 Forest Officers.
3 Assistant Surveyors.	2 Tracers.
2 Temporary Surveyors.	

(ii.) EXISTING STATE OF TOPOGRAPHY.

No systematic topographical work has been done.

(iii.) WORK OF THE PAST YEAR.

(*a*) *Trigonometrical.*—No work was done.

(*b*) *Topographical.*—No work was done.

The topographical party, mentioned in last year's report, has not yet been sent out, and the question is still under consideration.

(*c*) *Cadastral.*—A considerable amount of chain surveying and traverse work was done in the year under review, chiefly in the Cayo and Toledo districts, and in the towns of Benque Viego and Soccoths. The re-survey of Stann Creek Town of over 700 lots was completed. This took up the work of two surveyors for the greater part of the year.

(*d*) *Map production.*—A new general map of the Colony on the scale of $\frac{1}{380160}$ has been reproduced at the Ordnance Survey Office, Southampton, and will be on sale by Messrs. Stanford & Son.

Four hundred and thirty-six tracings were made during the year.

(*e*) *Expenditure.*—The total expenditure for the year was $18,437, and the revenue from timber licences, sale and rent of land, &c., was $27,198.

CEYLON.

Governor ... ... Col. Sir H. E. McCallum, G.C.M.G., R.E.

Surveyor General ... ... Mr. R. S. Templeton, A.I.C.E., F.R.G.S.

(i.) Staff.

Field.	*Office.*
8 Superintendents of Surveys.	7 Assistant Superintendents of Surveys (Temporary).
1 Superintendent of Surveys (Temporary).	72 Clerks and Draughtsmen.
10 Assistant Superintendents of Surveys.	108 Clerks and Draughtsmen (Temporary).
18 Assistant Superintendents of Surveys (Temporary).	185 Piece-workers.
1 Assistant Astronomer.	15 Volunteers.
31 Grade Surveyors.	
234 Supernumerary Surveyors.	
2 Instructors of Surveying.	

(ii.) Existing State of Topography.

A certain amount of country has been surveyed topographically on the 2-inch and 1-inch scales, but so far no sheets have been published.

(iii.) Work of the Past Year.

(*a*) *Trigonometrical.*—No field work was done, but the calculations for fixing points in schemes covering 1,642 square miles were finished, 277 points being established.

(*b*) *Topographical.*—374 square miles on the two inches to one mile scale with 50 feet contours, and 256 square miles on the one inch scale, without contours, were surveyed during the year.

(*c*) *Block Surveys.*—During the year 79,000 acres were block surveyed.

(*d*) *Levelling.*—124 miles of initial levels were run in duplicate.

(*e*) *Expenditure:*—

	Rs.
Personal emoluments	537,797
Other charges	511,642
Special expenditure	211,766
Total	1,261,205
Amount allotted	1,439,127

In October, 1911, the Governor of Ceylon, who was then in England, discussed the work of the Survey Department with the

Colonial Survey Committee. His Excellency concurred in the following recommendations of the Committee which have subsequently been considered by the Ceylon Government and approved.

(*a*) An account of the triangulation of Ceylon, primary and secondary, will be published in book form. This account will give the description of every station, the observed and reduced angles, the length of all the sides, the initial azimuth, the co-ordinates of each point and the trigonometrical height of each point, an account of the present condition of each station, explanatory charts and diagrams, concluding with an account of the probable errors of the various results and the methods of reduction adopted.

(*b*) An account of the levelling will be published in book form, giving the determination of mean sea level, its probable error and connection with the levelling, a description of the lines of levelling, its separation into primary and secondary levelling, a list of the main levelled heights with descriptions and values, charts and diagrams, an account of the method of reduction and description of patterns of benchmarks.

(*c*) It is also to be noted that in future the main traverse points are to be run between trigonometrical points and are to be marked with stones or in some other permanent fashion. Every care is to be taken to ensure that these traverse circuits shall be treated as permanent records of great value, lists of co-ordinates are to be kept in an accessible form, general diagrams are to be published, the errors and methods of adjustment are to be described and generally the circuits are to be treated as part of the main, permanent, geographical framework of the island. A book is to be published giving the necessary information on these points.

(*d*) With regard to the slow rate of progress of the Topographical Survey no decision has yet been come to as to how this work is to accelerated.

(*e*) The Settlement Survey is to be completed before any attempt is made to commence a Cadastral Survey, which will be required chiefly for registration of titles.

CYPRUS.

Governor	Sir CHARLES A. KING-HARMAN, K.C.M.G.
Registrar-General	Mr. F. O. J. ONGLEY.
Chief Surveyor	

Since the last report of the Colonial Survey Committee, Captain Lyons, F.R.S., has made a detailed report on the state of the surveys in the Island. He has also submitted proposals for the further carrying out of the work, which have been approved.

The staff approved is :—

1 Assistant Director.
2 Chief Surveyors.
5 Surveyors.
13 Detail Surveyors and Probationers.
1 Chief Draughtsman.
7 Draughtsmen.
4 Computers.

Captain Lyons' Report was published in 1912.

Existing State of Topography.

At present the only topographical sheets of the island are those on the 1-inch scale produced from a survey carried out under the direction of Captain (now Viscount) Kitchener, and published in 1885.

The Work of the Past Year.

(*a*) *Trigonometrical.*—76 minor stations have been fixed and observed from and 4 intersected points observed into. The average distance apart of these stations is about 2½ miles and the area embraced is about 260 square miles.

Two Base Lines of about 10,000 feet have been measured but no details are available regarding them.

(*b*) *Topographical.*—None done during the year.

(*c*) *Cadastral.*—The survey of the town of Nicosia on the scale of $\frac{1}{1250}$ has been completed. The work is based on a framework of triangles outside the town, with closed polygon traverses running through the town connected with the triangulation.

The total cost of this survey was £317 which works out at 15*s.* per acre.

Chain Survey.—The progress in this department has been satisfactory, particularly since the completion of the Nicosia town survey.

Surveyed during 1911–12 ... 83,660 acres.

This leaves 1,542,580 acres to be surveyed.

(*d*) *Field Registration.*—The following work was done during the year :—

Holdings valued	...	...	60,465 acres.
„ recorded	...	...	36,775 „
Waste land „	...	...	6,412 „

Compulsory Registration has been carried out in three villages. 39,230 Title Deeds have been issued in respect of 21,204 Plots.

(*e*) *Expenditure* :—

	£
Chain Survey	2,569
Map production	918
Registration branch	1,173
Office work	467
Compulsory registration	610

FEDERATED MALAY STATES.

High Commissioner ... ... Sir ARTHUR YOUNG, K.C.M.G.
Surveyor-General ... ... Colonel H. M. JACKSON.

(i.) STAFF.

Surveyor-General.
1 Deputy Surveyor-General.
5 Superintendents.

Field Staff.

1 Deputy Superintendent.
19 Assistant Superintendents.
47 Surveyors.
8 Surveyors on probation.
336 Native Surveyors.

Drawing Office.

1 Chief Draughtsman.
1 Superintendent Litho. Section.
1 Foreman Printer.
1 Instrument Repairer.
24 Native Staff.

Technical School.

1 Surveyor Instructor.
1 Assistant Surveyor Instructor.

The Survey Department of the Federated Malay States was formed in 1909 out of the old Federal Trigonometrical Department and the four State revenue surveys.

The work is divided into :—

(*a*) Revenue or land application surveys.
(*b*) Trigonometrical survey.
(*c*) Topographical survey.
(*d*) Levelling.
(*e*) Tidal observation.
(*f*) Magnetic survey.
(*g*) Mapping, &c.

The training of the European probationers is done partly at headquarters and partly in the field. The Asiatic probationers are trained for one year in the special technical school.

(ii.) PROGRESS UP TO AND INCLUDING 1911.

(*a*) *Trigonometrical.*—Up to the end of 1910, 45,180 square miles had been covered with triangulation and 1,953 miles of traverse had been executed, at a cost of £177,347.

In 1911 the following results are given :—

Stations fixed—major	21
„ „ minor	15
„ „ topographical	13
Precise traverse completed miles	315
Permanent marks in traverses	1,249

In the *precise* traversing the average closing error was 1 in 31,900.

In the triangulation of Johore the mean average correction to the 103 bearings is 1·22 seconds of arc, and the cost works out

to £93 for each of the 33 new points. The cost of precise traversing was £8 10*s.* per mile.

(*b*) *Topographical.*—It has been a matter of some difficulty to make satisfactory arrangements for the execution of the topographical surveys. The survey of India has been of great assistance in the matter of training and supplying the European staff.

Up to the present time 1,400 square miles have been topographically surveyed on the one inch scale and about 640 square miles on the two inches to one mile scale.

Of this, 952 square miles were completed during 1911, so that the work may just be said to be getting into order. The plane table is used, but a great deal of the work has to be traversed. Heights are determined with the Indian tangent clinometer.

The arrival of the colonial survey section, which left England in May, 1912, should help materially to expedite this class of work. The cost of topography is high and is likely to remain so, owing greatly to the high wages paid for unskilled labour.

(iii.) Revenue Surveys.

The principle adopted in carrying out the land revenue surveys is to base all the chain work or cut traverse boundaries on the triangulation and on precise or "standard" traverses of a high degree of accuracy.

The permissible errors are :—

For survey for	grants or mining leases	$\frac{1}{4000}$
" "	native holdings	$\frac{1}{3000}$
" "	town lots	$\frac{1}{8000}$

The out-turn of the revenue branch during 1911 comprised the survey of 15,322 lots with an acreage of 271,612. The work entailed the preparation of 21,044 title deeds.

The total expenditure of the Revenue Survey Branch was £85,336, of which £35,328—about 41 per cent.—was recovered in fees.

(iv.) Central Survey Office.

This was completed towards the end of 1910 and includes an installation of lithographic machines, presses, &c., and a complete photographic apparatus. Electric power is being installed. The difficulties to be overcome at the commencement were great.

During 1911 two maps on the two-inch scale were produced. The ordinary work of the drawing office was satisfactory, and the maps of the Anglo-Siamese boundary were commenced.

(v.) Special.

During 1910 and 1911 the delimitation of the frontier between the Malay States and Siam was proceeded with and absorbed a considerable proportion of the personnel of the Trigonometrical Branch.

FIJI.

Governor ... ... Sir HENRY MAY, K.C.M.G.
Officer in Charge of the Trigonometrical Survey. Mr. G. T. McCAW.
Assistant ... ... Mr. T. RIMMER.

The field work of the Trigonometrical Survey of Viti Levu, which was commenced by Captain Ley, R.E., in August, 1908, was continued by Mr. McCaw and completed on March 7th, 1912.

Two bases have been measured at Navua and Lautoka. The preliminary calculations show that the latter reproduced on the former will show a discrepancy probably less than 6 in.

Altogether 49 main stations and a somewhat greater number of intersected points have been fixed and permanently marked in the island.

Altitudes throughout the island are derived from observations for M.S.L. conducted both at Navua and Lautoka, and with the zeros thus determined the bases at both places were tied by spirit levelling.

Astronomical observations were made at Nandi and Suva on opposite coasts. The preliminary results distinctly indicate local attraction to the extent of about 25 seconds in latitude and 20 seconds in azimuth. The discrepancies are in a sense to be anticipated from the configuration of the island. The Survey has been tied to the longitude pier at Suva—a main station of the great Trans-pacific Longitude chain.

Photogrammetry was continued by Mr. Rimmer during the year in the intervals when his services were not otherwise engaged. The total number of pairs of plates is 150, of which about 90 were obtained during the past season. A considerable strip of open country between Meba and Ra has thus been covered, together with certain isolated areas. It is hoped to have this work plotted in England during the current year.

About one-third part of the definitive results of the Trigonometrical Survey is complete. The remaining computations will be carried out in England by the Officer in Charge.

No topographical sheets have yet been published.

JAMAICA.

Governor ... ... Sir SYDNEY OLIVIER, K.C.M.G.
Surveyor-General ... ... Mr. COLIN LIDDELL.

There is no recognised Survey Department, but cadastral surveys, as they became necessary, are executed by the Crown Lands Department.

(i.) STAFF.

Surveyor-General.
2 Assistant Surveyors.
3 Clerks.
1 Typist.
122 Bailiffs and Headmen.

(ii.) Existing State of Topography.

No topographical sheets exist.

(iii.) The Work of the Past Year.

(*a*) *Trigonometrical and* (*b*) *Topographical.*—No work of this nature has been done.

(*c*) *Cadastral.*—This work which includes the surveys of lands forfeited to the Crown for the non-payment of taxes, and of lands sold by and to the Crown, is done by closed traverses. During the past year 94 lineal miles of traverse work was done.

(*d*) *Map production.*—About 1,500 pentagraph reductions have been made from the 4-inch cadastral maps, and the remainder of the cadastral maps have been reduced by photography to the one inch scale for the proposed general map of the island on this scale.

(*e*) *Expenditure.*—It is impossible to get the exact figure spent on purely survey work, but the total expenditure of the Department was £2,898.

TRINIDAD.

Governor ... ... Sir George R. Le Hunte, K.C.M.G.
Engineer in charge of Surveys ... Mr. E. R. Smart.

(i.) Staff.

Engineer in Charge of Surveys.

2 Assistants.
4 Draughtsmen.

1 Clerk.

(ii.) Existing State of Topography.

No topographical sheets exist, but a map has been published by Messrs. Stanford & Son in 11 sheets on the $\frac{1}{50000}$ scale showing concession boundaries and a certain amount of detail.

(iii.) The Work of the Past Year.

(*a*) *Trigonometrical.*—This branch has been abolished. The trigonometrical survey was begun in April, 1901, and the whole island was covered by the primary triangulation. The base (8,600 feet in length) was measured with a steel tape and the angles were observed with an 8-inch Troughton & Simm's theodolite. A second base was measured and found to differ from the calculated length by 8 inches. The longest side in the primary triangulation was 40 miles. The angles were not reduced by the method of least squares, but by an approximate method. The triangular error in

the primary triangulation never exceeded 3 inches. In the secondary triangulation the length of the sides was from 8 to 10 miles and in the tertiary as little as 2 miles. The triangular error in the minor triangulation was 12 inches. The latitude and longitude of a point in the battery at Port of Spain was fixed by the United States Geodetic Survey and the latitudes and longitudes of the trigonometrical points have been calculated from it. The points of the primary triangulation are marked with pillars. In addition to fixing trigonometrical points the trigonometrical department carried out traverses along the principal roads and along some of the rivers and water-sheds. The main object was to provide fixed points from which the Crown Surveys Department could carry out surveys for the fixing of boundaries of lands and concessions.

(*b*) *Topographical.*—The work has been confined to *Tobago* and *Cedros.* In the former 80 miles of roads have been surveyed and 14 ward maps of Tobago constructed on a scale of 12 chains to an inch. In Cedros a survey was made of the Lagoons and Public Roads. No effort has, however, been made to carry out a systematic topographical survey, but a considerable amount of detail has been fixed, and as position depends on the trigonometrical survey, and is therefore accurate, the preparation of a topographical map would not be a great matter, and it is much to be desired that it should be undertaken.

(*c*) *Cadastral.*—280 petitions of Crown Land varying in size from ¼ acre to 40 acres were surveyed, mostly by private surveyors working at the rate of 2/3 per chain of 66 ft.

(*d*) *Map production.*—The ward maps of Trinidad have been brought down to 116 sheets each 40 inches by 27 inches. These are gradually being plotted by the staff and coordinated to the trigonometrical data Eleven out of the twelve sections of Trinidad on the scale of $\frac{1}{50000}$ showing the work of the Trigonometrical Survey were engraved on copper.

(*e*) *Expenditure:*—

	£	*s.*	*d.*
Salaries	1,855	0	0
Travelling	116	17	0
Surveys	2,591	12	2
Office	8	3	2

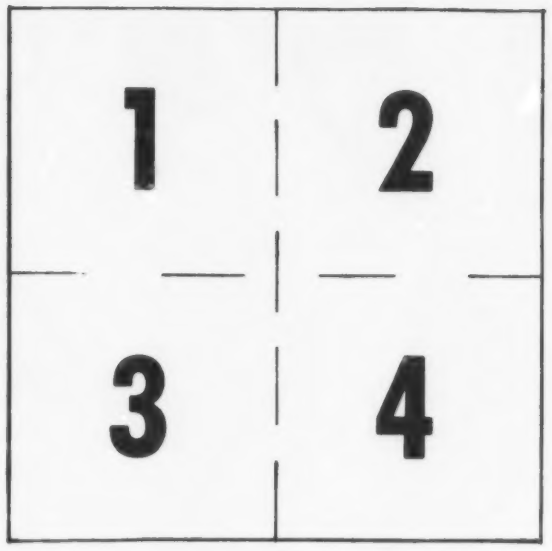
V.

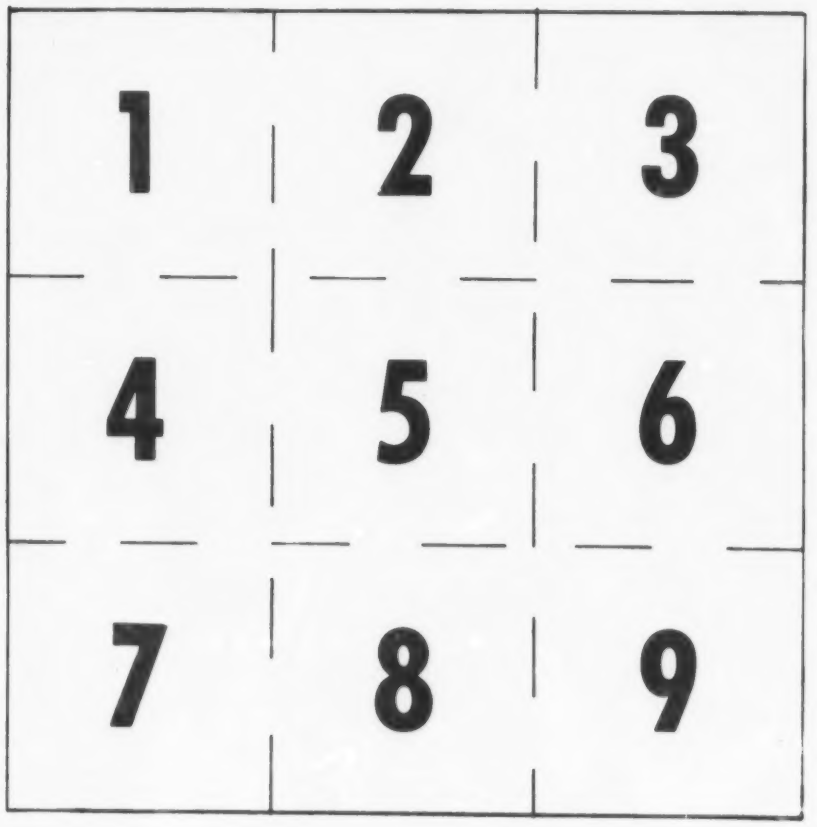
WORK OF BOUNDARY COMMISSIONS DURING THE YEAR.

During the year two Boundary Commissions were at work in Africa.

1. Anglo-German-Belgian Commission in the neighbourhood of the 'Mfumbiro Mountains.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





To face page 37.

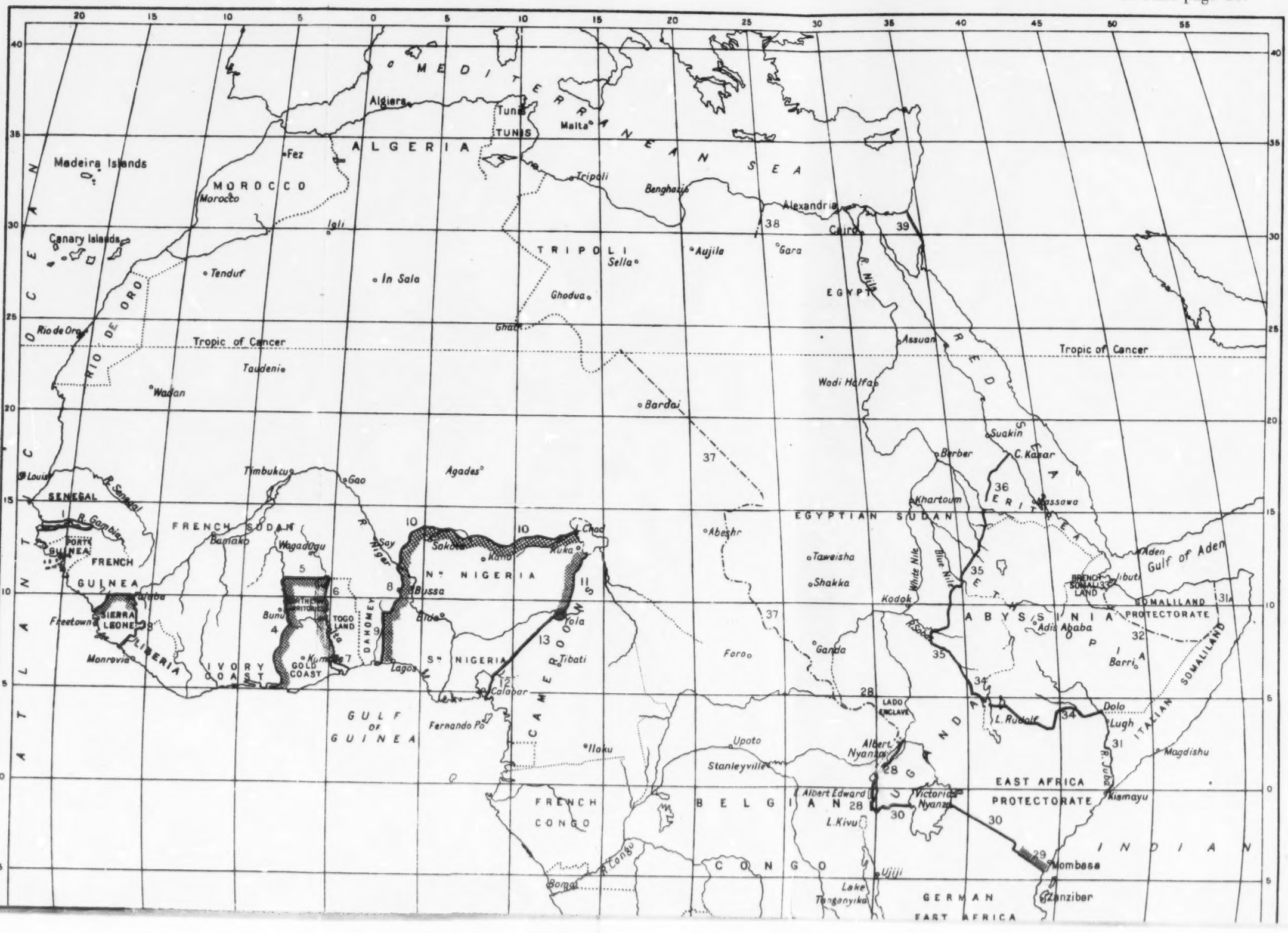


DIAGRAM TO ILLUSTRATE THE PROGRESS OF THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA

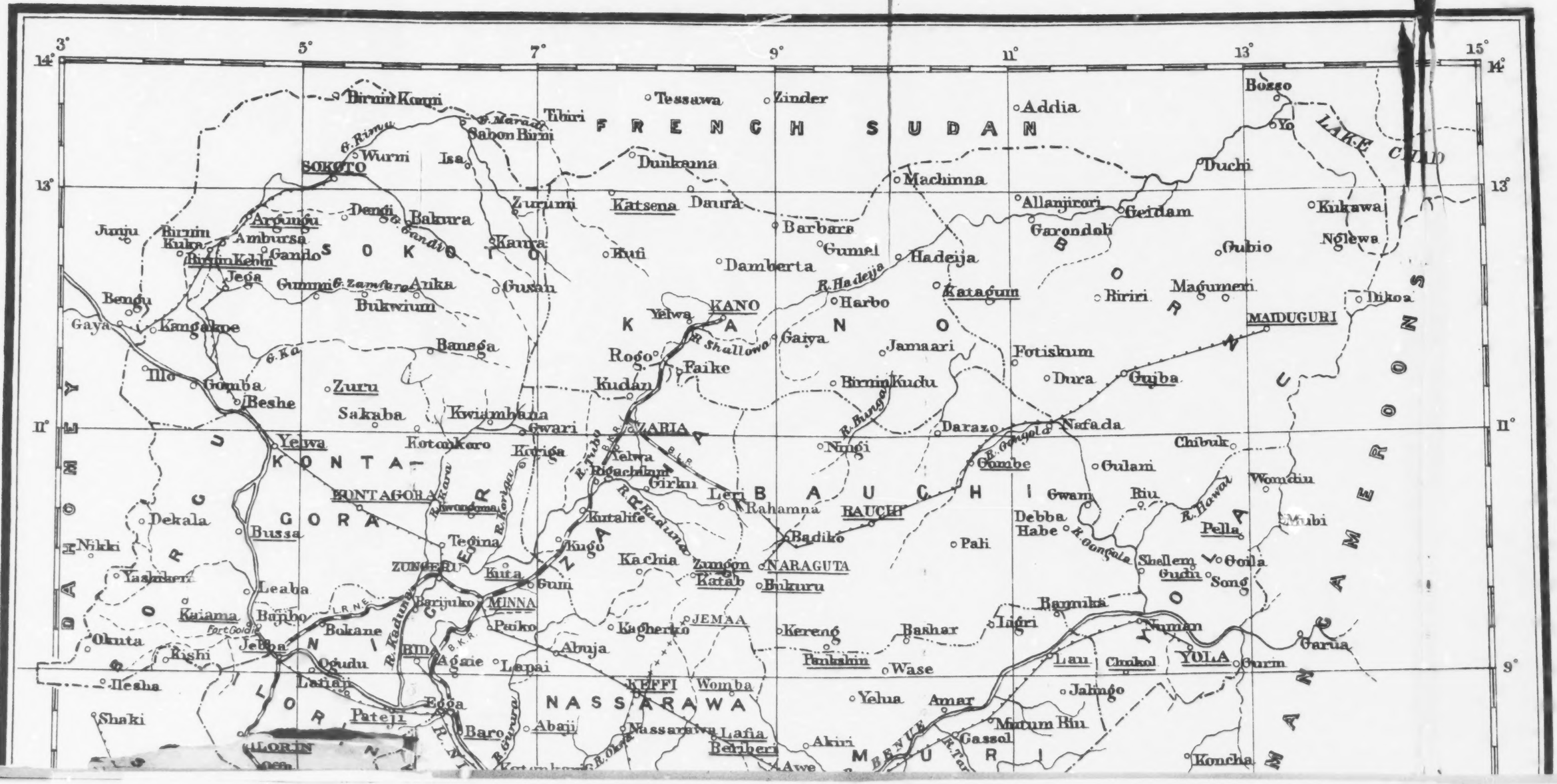
Scale of the Diagram
26,313,000 or 1 Inch to 450 Miles
Miles 100 0 100 300 500 700 900 Miles

British Boundaries marked & ratified
Do. Do. surveyed
Do. Do. not yet surveyed

G.S.G.S. Nº 2226 (a)

War Office. August 1906.
Revised July, 1912.

OUTLINE MAP
OF
NORTHERN NIGERIA



S.O. Nº 1376

Printed at the Ordnance Survey Office Southampton. 1912.

Scale $\frac{1}{4,000,000}$ or 1·014 Inches to 64 Miles

Miles 60 40 20 0 100 200 300 400 Miles

REFERENCE

Railway constructed
" under construction
Road proposed
Telegraph constructed
" under construction
" proposed
Headquarters of Administrative Districts underlined

The British section was composed as follows :—

Commissioner	... ...	Captain (temporary Major) E. M. JACK, R.E.
Assistant Commissioner	...	Captain the Hon. F. R. D. PRITTIE, Rifle Brigade.

Company-Serjeant Major H. HIGMAN, R.E.
Corporal G. ARCHER, R.E.
Lance-Corporal S. POWELL, R.E.

The work in the field began in February, 1911, and was completed in August, 1911.

The region surveyed is a singularly interesting one, being for the most part an upland country, 6,000 feet above the sea, diversified with small lakes. To the S.W., is the great volcanic chain of the 'Mfumbiro or Virunga Mountains, one of which, Mount Sabinio, forms the boundary point where British, German and Congo territory meet.

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2. Anglo-Belgian (Rhodesia-Congo) Boundary Commission.

The British section was composed as follows :—

Commissioner	... ...	Major R. A. GILLAM, R.E.
Assistant Commissioner	...	Captain L. W. D. EVERETT, Welsh Regiment.
,, ,,	...	Captain R. WALKER, R.E.
,, ,,	...	Lieutenant S. GORE-BROWNE, R.F.A.
,, ,,	...	Lieutenant O. E. WYNNE, R.E.

And Six Non-Commissioned Officers, R.E.

The Commission left England in July, 1911, and met the Belgian section at Sakania on the 1st September.

The total length of the boundary is 1,100 miles, and the joint instructions given to the Commissioners include the surveying of a large tract of country. It is expected that the work will take nearly three years to complete.

The British Commissioner reports that he has identified the two points, Msenguli and Chantuntile, of the Rhodesian geodetic triangulation, and this forms an excellent base for the carrying out of the triangulation. Up to the 31st March, 1912, approximately 6,000 square miles of ground had been triangulated with an average triangular error of 5·7 seconds. The topographical work was naturally delayed until trigonometrical points became available, and between January and March the heavy rains delayed progress. Work is now progressing well.

The Commission suffered a sad loss in the death of Captain Everett, who succumbed to injuries received in an encounter with a wounded lion on the 18th October, 1911.

Captain E. A. Steel, R.F.A., has since been appointed.

V.

TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS.
1	Gambia (Anglo-French)	425	Aug. 10th, 1889 ..	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Lacomte, Civil Administrator	Nov., 1890, to May, 1891	May, 1891	June 9th, 1891.	—	—
1	" "	—	" "	British :— Mr. Reeve. Mr. Ozanne. French :— M. Fargue. Lieut. de Jussien. M. Robert (Interpreter).	1895-6.	—	—	—	—
1	" "	—	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898-9.	—	—	—	—
1	" "	—	April 8th, 1904	British :— Major Cowie, W. I.R. Mr. B. B. de Ta arner.	1905-6.	—	—	—	—
2	Sierra Leone—French Guinea.	260	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Capt. A. H. Kenney, R.E. French :— M. Lamador, Governor of the French Colony of Les Rivières-du-Sud.	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembi-Kunda.
2	" "	—	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Millot.	Dec., 1895, to May, 1896.	1895, 1896.	April 9th and 30th, 1896.	June 14th and 16th, 1896.	From the Coast to Tembi-Kunda.

2	Sierra Leone—French Guinea.	8	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Mr. Birch. French :— M. Lescure.	1900 and Jan. 15th, 1903.	1903.	Mar. 12th, 1903.	Exchange of notes, Mar. 22nd and April 5th, 1904.	Tembi-Ku d[illegible] Eastwards
			Exchange of Notes, 6th July, 1911.	British :— Capt. le Mesurier. French :— Capt. Antony Cottes.	—	1911.			Handing over country.
3	Sierra Leone—Liberia ..	195	Nov. 11th, 1885	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E. Liberian :— Mr. J. McCarthy.	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	Jan. 21st, 1911.	
			21st January, 1911 ..	British :— Major E. L. Cowie, W. I. R. Capt. J. G. V. Hart, W. I. R. Liberian :—	.	1912.			From Junction of Moa River with 13° W. of Paris to Junction of rivers Morro and Mano.
4	Gold Coast—Ivory Coast (Anglo-French).	450	July 12th, 1893	British :— Major A. E. G. Watherston, R.E. Capt. Soden, R. Fus. Capt. H. B. Des Voeux, R.E. French :— M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903.	Feb. 1st, 1903.	May 11th and 15th, 1905.	—
5	Gold Coast, Northern Territories — French Sudan, Senegambia-Niger (Anglo-French Boundary North of Gold Coast).	195	Convention, June 14th, 1898.	British :— Major A. E. G. Watherston, R.E. Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	—	Aug. 16th, 1901.	—	—
5	„ „	„	Agreement, Mar. 18th/ April 25th, 1904.	British :— Capt. J. O'Kinealy. French :— Lieut. F. Verlaque.	—	1904.	Oct. 19th, 1904.	May 24th/ July 19th, 1906.	—
6	Gold Coast, Northern Territories — Togo (Anglo-German).	165	Convention, Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E. Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried.	Dec., 1901, to Sept., 1902.	—	July 21st, 1902.	—	—
6	„ „	„	„ „	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.	—	Sept., 1904, to Dec. 15th, 1905.	—	June 25th, 1904.	North of 9th parallel only.

Red Nos. on Map.	Name of Boundary.	Length. Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally Approved.	REMARKS.
7	Gold Coast — Togoland (Anglo-German).	125	Convention, July 1st, 1890.	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	1904.	Oct. 11th, 1904.	—	—
8	Lagos—Dahomey (Anglo-French).	235	June 14th, 1898	British :— Major J. I. Lang, C.M.G., R.E. French :— Commdt. Touteé.	1900.	—	Dec. 22nd, 1900, and Jan., 1905.	Oct. 19th, 1906.	From 9° N. Lat. to Niger.
9	" " ..	200	August 10th, 1889, July 12th, 1893.	British :— Mr. F. C. Fuller. Mr. A. G. Fowler. Dr. Hay. French :— Capt. J. Plé. Lieut. Brisson	1895-6.	—	Oct 12th, 1899, Art. II. June 14th, 1898.	Oct. 19th, 1906.	From the Coast to 9° N.Lat. Treaty Series No. 15, 1899. In one section change of
9	" " ..			British :— Capt. Anderson. French :— M. Perreur.	1900.	—	—	—	—
10	Niger—Chad (Anglo-French).	860	June 14th, 1898, April 8th, 1904.	British :— Lieut.-Col. G. S. McD. Elliott, R.E. Capt. C. H. Foulkes, R.E. Capt. G. R. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty. Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906, May 29th, 1906.	—	—
10	" " ..	"	May 29th, 1906	British :— Major R. P. O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Andoin. Lieut. Vignon.	1906, 1907.	1907, 1908.	Feb. 25th, 1908, and Feb. 19th, 1910.	Exchange of Notes, May 17th, 1911, and July 1st, 1911.	Treaty Series No. 1, 1912.

11	Yola—Chad (Anglo-German).	350	Convention, Nov. 15th, 1893 Preliminary Agreement, Dec. 2nd, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B. Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Aug. 10th, 1903, Feb., 1903, to Feb., 1904 and 1905.	—	Feb. 24th, 1904, and Mar. 19th, 1906.	July 16th, 1906	(Treaty Series, No. 17, 1906.)
11	" "	40	" "	Local Commission to mark Boundary :— British :— Mr. Hans Fischer. German :— Leut. von Stephani.	—	1906 to 1907.	Feb. 12th, 1907.	Mar. 5th, 1909.	From Gorege to Lake Chad. (Treaty Series, No. 17, 1909.)
11	" "	81	" "	British :— Capt. Vicars Boyle. German :— Capt. von Stephani.	—	1907.	Mar. 11th, 1907.	Mar. 5th, 1909.	From Uba, on Yedseram River, to River Benue.
12	Cross River (Southern Nigeria—Kameruns).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug. 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th, 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1886.	—	—	—	Cross River to the Sea.
12	" "	"	" "	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	—
13	Cross River Rapids—Yola Arc.	285	Nov. 15th, 1893	British :— Lieut-Col. G. F. A. Whitlock, R.E. Capt. H. T. G. Moore, R.E. Lieut. W. V. Nugent, R.A. 2nd Lieut. W. D. Downes, Royal Sussex Regiment. German :— Major Haering. Oblt. von Stephani. Oblt. Cuno. Oblt. Rothe.	Aug., 1907, to May, 1909.	—	April 16th, 1909.	—	—
14	Barotseland—Angola ..	710	Convention, July 11th, 1891, and Arbitration award, May 30th, 1905.	——	—	—	—	—	Not yet delimited.

Red Nos. on Map.	Name of Boundary	Length Miles.	Treaty concerned and Date.	Commissioners.	Dates of				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	—	—	—	—	—	Not yet delimited.
16	Bechuanaland—German South-West Africa.	1113	July 1st, 1890, Art. III. (A.G.), Dec. 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British :— Major H. D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1898 to 1903.	—	—	Part only of boundary delimited.
16	Cape Colony—German South-West Africa (Orange River).		July 1st., 1890, Art. III.	—	—	—	—	—	Not yet delimited.
17	Amatongaland—Portuguese East Africa.	80	June 11th, 1891, Art. III.	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	Aug., 1896, to Dec., 1896	—	—	—	—
17	" "	"	" " "	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	—	Aug. and Oct., 1897.	Oct. 2nd, 1897.	Dec. 29th, 1899/Jan. 25th, 1900.	—
18	Swaziland—Portuguese East Africa.	66	Conference, April to June, 1907.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1893, 1894, and 1897.	April, 1907	—	—	Portuguese and Boer Commission.
19	Transvaal—Portuguese East Africa.	255	July 29th, 1869, Convention of London, Feb. 27th, 1884.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major A. Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1887, 1890, and 1894.	1887, 1890, 1894.	—	—	Portuguese and Boer Commission.

20	Limpopo River to Sabi River (Anglo - Portuguese).	115	June 11th, 1891	British :— Mr. W. J. Atherstone. Portuguese :— José A. Serrano.	Dec. 1902, to July, 1903.	—	Dec. 21st, 1903/July 19th, 1904.	June 3rd, 1907.	In one exchange of notes.
21	Mazoe or Manica Boundary (Anglo - Portuguese 18° 30′ S. to Sabi River).	235	June 11th, 1891, and Arbitral award, Jan. 30th, 1897.	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	June 3rd, 1907.	
21	" "	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade.	—	1898, 1899.	June 5th and 28th, 1898, and Dec. 14th and 15th, 1898.	—	—
22	Barue Boundary (Anglo-Portuguese, River Mazoe, and 18° 30′ South).	145	June 11th, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E. Portuguese :— Capt. Garcia Rosado.	1898.	1905	Dec. 23th, 1898.	Mar. and April, 1902, Jan. and April, 1904.	Exchange of notes.
23	Anglo-Portuguese Boundary South of River Zambesi.	215	" "	British :— Mr. Sawerthal. Portuguese :— Lieut. Durao	1903–4.	—	—	—	Provisional survey.
23	" "	215	" "	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doncet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. S. Gugo Coutinho.	April 1905, to Oct., 1905.	1906.	Oct. 4th, 1905.	Exchange of Notes 21st Oct., 1911, 20th Nov., 1911.	—
23	" "	47	" "	British :— Mr. E. R. Morkell. Capt. J. Tait, B.S.A. Police. Portuguese :— Luiz Lopes de Conceicas, Junior. Jayme Lino.	—	—	Nov. 13th, 1910.	—	Line from Mount Gungwa to Mount Chera taken over.

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of Delimitation Survey.	Dates of Marked on Ground.	Dates of Protocol signed.	Dates of Finally approved.	REMARKS.
24	Anglo-Portuguese Boundary North of Zambesi.	260	June 11th, 1891	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. S. Gugo Coutinho.	June, 1904, to Nov., 1904.	1904	Nov. 21st, 1904.	Exchange of Notes 21st Oct., 1911, 20th Nov., 1911.	—
25(a)	Nyasaland Protectorate —Portuguese East Africa (Anglo-Portuguese).	660	„ „	British :— Mr. J. F. Cunningham. Mr. T. I. Binnie, Surveyor. Portuguese :— Capt. Ferraz. Conde. Du Pont. Capt. Branco.	July to Nov., 1899. Oct. to Dec., 1900.	1899–1900.	Dec. 8th, 1900.	*Sept. 15th, 1906.	Section from River Ruo to Lake Chiuta Provisional Boundary Commission.
25(b)	„ „			British :— Mr. A. James Swann. Mr. Thomas I. Binnie, Surveyor.					
25(c)	„ „	91	„ „	Local Commission :— British :— Mr. A. J. Swann. Mr. T. F. Firr, Surveyor. Portuguese :— 2nd Lieut. Antonio de Brito.	—	1907.	—	—	To make some alterations to previous line. Beaconed from B.P. 38 to Mt. Kapiriuta.
25(d)	„ „	—	June 11th, 1891	Local Commission :— British :— Mr. T. I. Binnie. Portuguese :— Ernesto Tavares D'Almeido Carvalho.	April–May, 1908.	—	May 22nd, 1908.	Exchange of Notes, 6th and 30th Nov., 1911.	Ruo and Shire Rivers.
26	Nyasa-Tanganyika (Anglo-German)	225	July 1st, 1890	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Boileau, R.E. Capt. C[illegible]chester. Lieut. Scratchley. German :— Hptmann Herrmann. Leut. Glauning. Dr. Kohlschütter.	1898.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—

27	Congo Free State—Northern Rhodesia.	1,200	May 12th, 1894	British :— Major R. A. Gillam, R.E. Capt R. Walker, R.E. Capt. E. A. Steel, R.A. Lieut. S. Gore-Brown, R.F.A. „ O. E. Wynne, R.E. Congolese :— Major Begraud. Capt. Weber. Lieut. Lepoivre. „ Gendarme. „ van Bleyenberg. „ Wuidart. „ Donner. „ Ermeus.	1911-12.	—	—	—	—
28	Congo Free State—Uganda.	800	May 12th, 1894, and May 9th, 1906.	British :— Lieut.-Col. R. G. T. Bright, C.M.G., Rifle Brigade. Capt. E. M. Jack, R.E. Lieut. Hon. F. R. D. Prittie, Rifle Brigade. Congolese :— Commandant E. Mercier, 2nd Regiment des Guides. Commandant J. Bastien, 2nd Regiment des Grenadiers. Commandant Stockhausen. Lieut. Weber. Lieut. Mauray.	Jan., 1907 to April, 1908.	—	—	—	—
28	„ „ „	36	—	British :— Major E. M. Jack, R.E. Capt. Hon. F. R. D. Prittie, Rifle Bgde. Congolese :— Capt. Commandant J. Bastien. Capt. Maury Lieut. Weber. Lieut. Wuidart.	—	1911.	May 4th, 1911.	—	From Mount Sabinio to Mount Nkabwa.
29	British — German East Africa (Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith, R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 25th, 1893.	—	—
29	„ „ „	„	July 25th, 1893	British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897.	1900.	Jan. 26th, Feb. 14th, and April 25th, 1900.	—	Not beaconed throughout its entire length.

* Provisional confirmation of recommendations of Boundary Commissioners, 1899 and 1900 (Procès Verbal, December 8th, 1900).

Red Nos. on Map.	Name of Boundary.	Length, Miles.	Treaty concerned and Date.	Commissioners.	Dates of				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
30	British — German East Africa (South end of Jipe to Lake Victoria).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	—
30	German East Africa—Uganda.	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G. T. Bright, Rifle Bde., Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	July, 1902, to Apr. 1904.	1904.	July 18th, 1906.	—	—
30	" " "	65	—	British :— Major E. M. Jack, R.E. Capt. Hon. F. R. D. Prittie, Rifle Bgde. German :— Major Schlobach. Hptmann Fouck.	—	1911.	Oct. 30th, 1911.	—	Mt. Sabinio to R. Chizinga.
31	Italian Somaliland — British East Africa.	375	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
31(a)	British Somaliland — Abyssinia.		May 14th, 1897, June 4th, 1897.	—	—	—	—	—	Not yet delimited.
32	British Somaliland — Italian Somaliland.	710	March 24th, 1891 ..	—	—	—	—	—	Not yet delimited.
33	British Somaliland — French Somali Coast.	50	February 2nd, 1888 ..	—	—	—	—	—	Not yet delimited.
34	Uganda and East Africa —Abyssinia Boundary.	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900-01.	—	—	—	—
34	" " "	"	—	Capt. P. Maud, R.E. Mr. J. Baird.	Oct. 1902, to July, 1903.	—	—	—	—

34	" " "	"	December 6th, 1907 ..	Major C. W. Gwynn, C.M.G., D.S.O., R.E.	1908.	1908.	—	—	
35	Sudan—Abyssinia ..	760	Treaty, May 15th, 1902	Capt. R. L. Waller, R.E.	1909.	1909.			
				Major H. H. Austin, R.E.	—	—	—	—	
35	" " ..	"	" " "	Lieut. C. W. Gwynn, R.E.					
36	Sudan—Eritrea	330	December 7th, 1898, June 1st, 1899, April 16th, 1901, November 22nd, 1901, May 15th, 1902.	Brev.-Major C. W. Gwynn, R.E., D.S.O.	1903.	1903.	—	—	—
				British :—					
				Col. the Hon. M. G. Talbot, R.E.	1903.	—	—	—	R. Setit to Abu Gamal.
				Italian :—					
				Major Martinelli					
				Tenente. A. Pollera.					
				Capt. Tornare.					
36	" " ..	"	" " "	Brev.-Major W. J. Walter, Lancs. Fus.	1899, 1901.	—	—	—	From Sabderat North - Eastwards.
37	Anglo - French — From Congo-Nile Watershed to Tripoli.	1,950	March 21st, 1899 .. Treaty, Series 15, 1899.	—	—	—	—	—	Not yet delimited.
38	Egypt—Tripoli	1,000	—	—	—	—	—	—	Not yet delimited.
39	Egypt—Turkish, Sinai Peninsula.	140	Firman, 1841	British :—					
				Capt. R. C. Owen.	1906.	1906.	—	Oct. 1st, 1906.	—
				Mr. Wade.					
				Mr. Keeling.					
				Turkish :—					
				Mazzaffer Bey					
				Fehim Bey.					

VI.

CLASSIFIED LIST OF THE STAFFS OF SURVEY DEPARTMENTS.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	EAST AFRICA PROTECTORATE.				
	Superintending Staff.				
Director of Surveys	Major G. S. Knox, R.E. ...	800	... ...	... ...	28th Dec., 1910.
Clerk—Storekeeper	Mr. A. Rehm	245	... ...	... ...	4th Jan., 1906.
Typist and Stenographer ...	Miss E. Rehm	80	... ...	... ...	1st Jan., 1909.
	Trigonometrical and Topographical Branch.				
Deputy Director of Surveys ...	Capt. G. C. Williams, R.E. ...	667	... ...	... ...	28th Dec., 1910.
Assistant „ „ ...	Lieut. A. M. Coode, R.E. ...	525	... ...	... ...	10th May, 1909.
„ „ „ ...	Capt. H. N. Kempthorne ...	525	... ...	... ...	8th Dec., 1911.
Surveyor	Mr. J. Healy, R.E.	300	... ...	... ...	10th Dec., 1909.
„	2nd Corpl. H. Thornton, R.E.	215	... ...	... ...	15th July, 1908.
„	L.-Corpl. J. P. Durkan, R.E. ...	215	... ...	... ...	15th July, 1908.
„	L.-Corpl. J. Rimmer, R.E. ...	215	... ...	... ...	20th Jan., 1909.
„	L.-Corpl. J. P. Garvey, R.E. ...	215	... ...	... ...	26th May, 1909.
„	L.-Corpl. A. Hursey, R.E. ...	215	... ...	... ...	10th Dec., 1909.
„	L.-Corpl. F. G. Loxton, R.E. ...	215	... ...	... ...	29th Dec., 1911.
„	L.-Corpl. H. O. Jones, R.E. ...	215	... ...	... ...	26th Jan., 1912.
	Cadastral Branch, Deputy Director's Office.				
Deputy Director of Surveys ...	Mr. A. E. Townsend	550	... ...	Pensionable	28th Dec., 1908.
Assistant „ „ ...	Mr. T. H. Galbraith	450	... ...	Pensionable	28th Dec., 1908.
Chief Clerk—Accountant ...	Mr. C. H. Chalk	174	£40 house allowance	... ...	7th July, 1911.
Assistant Accountant... ...	Mr. W. T. West	150	„ „ „	Pensionable	4th July, 1908.
Clerk	Mr. D. A. Maconachie	130	„ „ „	... ...	30th Nov., 1911.

					Cadastral Branch, Surveyors.								
District Surveyor	...	...	Mr. J. T. Stiles...	...	...	400	...	...	...	...	...	...	28th April, 1908.
" "	...	...	Mr. F. H. Jordan	...	...	400	...	...	...	...	...	...	1st March, 1909.
" "	...	...	Mr. G. Woodruff	...	...	380	...	...	...	...	...	...	1st July, 1910.
Senior Staff Surveyor...		...	Mr. D. G. Crofts	...	...	320	...	...	...	...	...	...	1st July, 1910.
" " "	...	...	Mr. A. G. Baker	...	...	300	...	...	...	...	...	...	1st April, 1911.
" " "	...	...	Vacant	...	...	300	...	...	...	...	...	...	—
" " "	...	...	Vacant	...	...	300	...	...	...	...	...	...	—
Junior Staff Surveyor...		...	Mr. J. Marsengo	...	...	280	...	...	...	...	...	...	1st March, 1907.
" " "	...	...	Mr. E. K. Boileau	...	...	295	...	...	...	...	...	...	10th July, 1908.
" " "	...	...	Mr. A. Bessler ...	...	...	280	...	...	...	...	...	...	14th Sept., 1908.
" " "	...	...	Mr. H. C. Anderson	...	...	265	...	...	...	...	...	...	1st July, 1910.
" " "	...	...	Mr. A. W. Fraser	...	...	250	...	...	...	...	...	...	24th July, 1911.
" " "	...	...	Mr. W. MacDonald	...	...	250	...	...	...	...	...	...	2nd Nov., 1911.
" " "	...	...	Mr. F. S. O'Molony	...	...	250	...	...	...	...	...	...	15th Jan., 1912.
Assist. Junior Staff Surveyor			Mr. H. M. Thornhill	...	...	120	...	...	...	...	...	...	14th June, 1910.
" " "		...	Mr. A. W. Morris	...	...	120	...	...	...	...	...	...	3rd Oct., 1911.
Indian Surveyor	...	...	Mohamed Din ...	...	...	136	...	...	...	...	...	...	4th Aug., 1903.
" "	...	...	Abdul Quadir Kan	...	...	64	...	...	...	...	...	...	27th June, 1907.
" "	...	...	Shib Dass ...	...	...	56	...	...	...	...	...	...	16th Sept., 1910.
Native Assistant Surveyor		...	Mr. A. Farrar ...	...	...	30	...	...	...	...	...	...	1st May, 1911.
" " "		...	Vacant	...	...	30	...	...	...	...	...	...	—
					Computing Office.								
Chief Computer	...	...	Mr. J. H. Williams	...	...	300	...	...	...	...	...	...	1st Aug., 1910.
Computer ...	...	...	Mr. A. E. Adamson	...	...	250	...	...	...	...	...	...	30th Nov., 1911.
"	...	...	Mr. G. C. Oakes	...	...	250	...	...	...	...	...	...	30th Dec., 1911.
					Drawing Office.								
Chief Draughtsman	...	...	Mr. C. J. B. Panting	...	...	265	...	...	...	...	...	...	15th Aug., 1906.
Draughtsman ...	...	...	Mr. A. E. Fischer	...	...	160	...	...	...	...	...	...	1st Aug., 1910.
"	...	...	Mr. M. W. Hayes	...	...	160	...	...	...	...	...	...	2nd Nov., 1911.
"	...	...	Mr. F. J. Gosden	...	...	160	...	...	...	...	...	...	29th Jan., 1912.
"	...	...	Mr. G. Taylor ...	...	...	160	...	...	...	...	...	...	29th Jan., 1912.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	Coast Land Settlement.				
Junior Staff Surveyor... ...	Mr. W. V. Coates	250	... ...	... ...	2nd Nov, 1911.
,, ,, ,, ...	Mr. G. E. Weston	250	... ...	... ...	2nd Nov., 1911.
Assist. Junior Staff Surveyor	Mr. C. E. Taylor	120	... ...	... ...	6th Oct., 1909.
,, ,, ,, ,,	Mr. R. J. Goulston	120	... ...	... ...	16th Sept., 1910.
,, ,, ,, ,,	Mr. W. C. Tappin	120	... ...	... ...	3rd Oct., 1911.
,, ,, ,, ,,	Mr. I. Lewison	120	... ...	... ...	1st Feb., 1911.
	Computing Office.				
Computor	Mr. J. H. McEwen	250	... ...	... ...	30th Dec., 1911.
	Drawing Office.				
Draughtsman	Mr. J. G. E. McKay	160	... ...	... ...	15th June 1911.
Indian Tracer	Aziz Bux	80	... ...	... ...	15th Aug., 1904.
,, ,, ...	Imamudin	36	... ...	... ...	24th Jan., 1912.
,, ,, ...	Ami Chand	40	... ...	... ...	14th Jan., 1911.
,, ,, ...	H. Singh	60	... ...	... ...	1st Aug 1908.
Indian Photographer	Behari Lall	44	... ...	... ...	1st Aug 1908.
	Record Room.				
Clerk	Mr. A. J. de Mello	72	... ...	... ...	1st Dec 1906.
	Mombasa Office.				
Office Assistant	Vacant	190	... ...	... ...	

GOLD COAST.

Director of Surveys	Capt. E. F. W. Lees, R.E. ...	800	£160 duty allowance, £36 horse allowance.	Temporary	4th Jan., 1908.
Assistant Director of Surveys, Trigonometrical and Topographical Branch.	„ H. A. Lewis Hall, R.E.	400–20–500	£80 duty allowance £120 commuted allowances.	„	18th May, 1910.
Assistant Concessions Branch	Lieut. P. J. Mackesy, R.E. ...	600	Nil	„	8th Feb., 1911.
Chief Surveyor, Cadastral Branch.	Mr. G. V. Mathieson	250–10–300	£120 commuted allowances.	Permanent	4th Jan., 1908.
Surveyor, Cadastral Branch ...	Mr. R. N. Kilby	250–10–300	£120 commuted allowances.	„	4th Jan., 1908.
„ Trigonometrical and Topographical Branch.	2nd.-Corpl. A. J. Jones, R.E....	250–10–300	£90 commuted allowances.	Temporary	19th June, 1909.
„ „ „ „	Sapper, B. J. Gee, R.E. ...	240	„ „ „	„	1st Oct., 1911.
Draughtsman	„ A. F. R. Morris, R.E....	250–10–300	15*s.* per month bicycle allowance.	„	6th April, 1910.
Native Surveyor	Mr. J. Armah Kwantreng ...	200–10–250	2*s.* per diem tent allowance.	Three years' probation	15th Sept., 1911.
Assistant Native Surveyor	Mr. E. J. Smith	120–5–150	1*s.* per diem tent allowance.	„ „ ...	1st Jan., 1908.
„ „ „ ...	Mr. H. E. Sagoe	120–5–150	1*s.* per diem tent allowance.	„ „ ...	1st May, 1910.
Native Draughtsman	Vacant	120–5–150	Nil	„ „	18th Jan., 1908.
4th Grade Clerk	Mr. A. F. Benson	60–5–80	Nil	Permanent	„ „

Cadastral Branch.

Surveyor	L.-Corpl. C. Gathergood, R.E.	240	£90 commuted allowances.	Temporary	31st May, 1911.
„	„ J. R. A. Miller, R.E....	240	„ „ „	„	2nd Feb., 1910.
„	„ G. F. Spice, R.E. ...	240	„ „ „	„	14th July, 1910.
	Sapper T. J. Lynch, R.E. ...	240	„ „ „	„	6th Sept., 1911.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	Water Supply and Drainage Schemes.				
Draughtsman	Sapper W. A. Crouch, R.E. ...	250	15*s.* per month bicycle allowance.	Temporary	14th Sept., 1911.
Surveyor	L-Corpl. P. Hallahan, R.E. ...	240	£90 commuted allowances.	,, ...	20th April, 1910.
,, ...	Sapper R. N. Corner, R.E. ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, F. H. Grandy, R.E ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, C. W. Heald, R.E. ...	240	,, ,, ,,	,, ...	28th Dec., 1910.
	Wallis Company Concessions.				
Draughtsman	Sapper D. Flanagan, R.E. ...	250	15*s.* per month bicycle allowance.	Temporary	8th Feb., 1911.
Surveyor	,, L. Treacy, R.E. ...	240	£90 commuted allowances.	,, ...	,, ,,
,, ...	,, M. M. Campbell, R.E.	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, E. G. L. Allen, R.E. ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, W. O'Connell, R.E. ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, J. F. Fleming, R.E. ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, M. J. Kennedy, R.E. ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, H. R. Halliday, R.E. ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, W. L. Sheridan, R.E....	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, J. Ralph, R.E.... ...	240	,, ,, ,,	,, ...	,, ,,
,, ...	,, M. F. Dunne, R.E. ...	240	,, ,, ,,	,, ...	,, ,,

SOUTHERN NIGERIA.

Headquarters.

Director of Surveys	Major F. G. Guggisberg, R.E., C.M.G.	900	£180 duty pay ...	5 years	1st April, 1910.
Office Superintendent ...	——	280–20–380	... ...	... ...	Vacant.
Chief Clerk	D. Akitoye	252–12–300	... ...	Pensionable	1st Jan., 1911.
Finance Clerk	J. S. Williams	60–6–90	... ...	„	1st Jan., 1911.
Store Clerk	J. F. Kiyonmi	60–6–90	... ...	„	1st Jan., 1912.
Director's Clerk	——	24–6–54	... ...	„	Vacant.
Temporary Clerk	F. Delalu	72	... ...	Temporary	1st Jan., 1912.
Chief Draughtsman and Map Curator.	J. A. Pratt	164–12–240	... ...	Pensionable	1st Jan., 1912.
Assistant Photographer ...	——	—	... ...	„	Vacant.
Chief Headman	Claudius Shyllon	48	... ...	„	1st June, 1910.

Topographical Branch.

Deputy Director of Surveys, Topographical Branch.	Capt. R. H. Rowe, R.A. ...	525	... ...	3 years	20th Sept., 1911.
Assistant Director, Trigonometrical Section.	Lieut. G. G. Waterhouse, R.E.	525	... ...	„	10th Aug., 1910.
Assistant Director Topographical Branch.	Lieut. H. E. Kentish, R.E. ...	525	... ...	„	30th Nov., 1910.
Assistant Director, Topographical Branch.	Lieut. G. H. Bell, S. Lancs. Regt.	525	... ...	„	11th April, 1912.
Senior Surveyor	——	400–20–500	£80 duty pay ...	... ...	Vacant.
Surveyor	Mr. E. N. Thomas	300–20–400	... ...	Pensionable	1st Jan., 1911.
„	L.-Corpl. J Gawthorne, R.E....	200	... ...	3 years	10th Aug., 1910.
„	2nd Corpl. R. Hosking, R.E. ...	225	... ...	„	20th Sept., 1911.
„	L.-Corpl. H. Clark, R.E. ...	200	... ...	„	10th Aug., 1910.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	Topographical Branch—continued.				
Surveyor	L.-Corpl. C. Wharton, R.E. ...	200	... ...	3 years	10th Aug., 1910.
"	L.-Corpl. A. Mullin, R.E. ...	200	... ...	"	10th Aug., 1910.
"	2nd Corpl. T. W. Pedley, R.E.	225	... ...	"	20th Sept., 1911.
"	L.-Corpl. Sarson, R.E. ...	200	... ...	"	20th Sept., 1911.
"	L.-Corpl. H. Clark, R.E. ...	200	... ...	"	10th Aug., 1910.
Chief Native Surveyor ...	J. C. Johnston	200–10–250	... ...	Pensionable	1st April, 1911.
2nd Class Native Surveyor ...	A. O. Craig	72–6–90	... ...	3 years from 1st Oct., 1911. Pensionable.	1st Jan., 1911.
" " " " ...	G. H. Euba	72–6–90	... ...	" " "	" "
3rd " " " ...	E. S. S. Wood	48–6–60	... ...	" " "	" "
" " " " ...	E. O. Aiyede	48–6–60	... ...	" " "	" "
4th " " " ...	J. B. Cole	40–4–48	... ...	3 years from 1st Oct., 1911.	" "
" " " " ...	R. A. Williams	40–4–48	... ...	" " "	" "
" " " " ...	A. A. Young	40–4–48	... ...	3 years from 1st Oct., 1912.	" "
" " " " ...	S. A. O. Isaacs	40–4–48	... ...	3 years	1st Jan., 1912.
" " " " ...	A. O. Pedro	40–4–48	... ...	"	1st July, 1912.
" " " " ...	H. R. Hoskyns	40–4–48	... ...	"	" "
1st Class Native Draughtsman	J. A. Pratt	96–6–150	... ...	Pensionable	1st Jan., 1911.
" " " " ...	G. J. Goyea	96–6–150	... ...	"	" "
Temporary Draughtsman ...	B. B. Sanya	36	... ...	2 years' probation ...	1st Jan., 1910.
" " ...	S. Cole	18	... ...	On probation	29th April, 1911.
4th Class Native Draughtsman	A. L. Ajiboye	40–4–48	... ...	3 years' probation ...	1st July, 1912.

		Cadastral Branch.			
Deputy Director of Surveys ...	Mr. A. Cleminson	500–20–600	£100 duty pay ...	Pensionable	29th Oct., 1906.
Lands Surveyor	Mr. R. L. Drouyn	400–20–500	£80 duty pay ...	,, ...	1st Jan., 1912.
,, ,, ...	Mr. R. A. Webb	400–20–500	,, ,, ...	,, ...	11th July, 1912.
1st Class Native Surveyor ...	I. T. Wey	96–6–150	... ...	,, ...	1st Jan., 1911.
3rd Class ,, ,, ...	R. Jones	48–6–60	... ...	Probation 3 years. Pensionable.	1st Jan., 1911.
4th Class ,, ,, ...	O. Olumide	40–4–48	... ...	Probation 3 years ...	1st April, 1911.
1st Class Native Draughtsman	A. A. Creppy	96–6–150	... ...	Pensionable	1st Jan., 1911.
2nd Class ,, ,,	H. St. J. Williams	72–6–90	... ...	,, ...	1st April, 1911.
4th Class ,, ,,	D. A. Mendis	40–4–48	... ...	3 years' probation ...	1st Jan., 1912.
,, ,, ,,	J. C. Elias	40–4–48	... ...	4 years' agreement ...	1st July, 1912.
,, ,, ,,	G. G. Cole	40–4–48	... ...	,, ,, ,, ...	
Clerk	S. Wilson	24–6–54	... ...	Pensionable	1st Jan., 1911.
		Special Cadastral Party.			
Superintendent	Mr. W. Wilson	400–20–500	£80 duty pay ...	1 year on Coast ...	16th Aug., 1911.
Surveyor	Sergt. H. Rutt, R.E.	275	... ...	,, ,, ...	,, ,,
,, ...	Sergt. G. Phillips, R.E. ...	275	... ...	,, ,, ...	,, ,,
,, ...	Corpl. S. Cant, R.E.	240	... ...	,, ,, ...	,, ,,
,, ...	L.-Corpl. E. H Allen, R.E. ...	200	... ...	,, ,, ...	,, ,,
,, ...	,, P. A. Codwin ...	200	... ...	,, ,, ...	,, ,,
,, ...	,, S. W. Barrett, R.E....	200	... ...	,, ,, ...	,, ,,
,, ...	,, S. Router, R.E. ...	200	... ...	,, ,, ...	,, ,,
,, ...	,, C. Smith, R.E. ...	200	... ...	,, ,, ...	,, ,,
,, ...	,, R. J. Orr, R.E. ...	200	... ...	,, ,, ...	,, ,,
,, ...	,, A. Carr, R.E. ...	200	... ...	,, ,, ...	,, ,,
,, ...	,, W. McIlroy, R.E. ...	200	... ...	,, ,, ...	,, ,,
,, ...	,, P. Sugrue, R.E. ...	200	... ...	,, ,, ...	,, ,,

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
	School and Meteorological.				
Chief Instructor	C. A. A. Barnes	252–12–300	... ...	On probation	1st Jan., 1911.
Meteorological Clerk	E. E. Solomon	24-6-54	... ...	Pensionable	" "
" "	W. F. Sancho	24–6–54	... ...	Training	1st July, 1910.
Pupil Surveyor	J. L. Tete	30	... ...	6 years, from 1.7.10 ...	1st July, 1911.
" "	H. M. Williams...	30	... ...	... ...	" "
" "	A. C. B. Cole	30	... ...	... ...	" "
" "	J. T. Bamgboshe	30	... ...	... ...	1st July, 1911.
" "	O. B. A. John	30	... ...	... ...	" "
" "	J. J. Medicros	30	... ...	... ...	" "
" "	V. O. Williams	20	... ...	6 years from 1.10.11 ...	1st Oct., 1911.
" "	M. J. Martins	20	... ...	" " " ...	" "
" "	S. O. John	20	... ...	" " " ...	" "
" "	F. G. Martins	20	... ...	" " " ...	" "
" "	N. Thompson	20	... ...	" " " ...	" "
" "	G. B. Benson	20	... ...	25th Oct., 1911 ...	25th Oct. 1911.
" "	W. A. Shylton	20	... ...	6 years from 30.10.11...	30th Oct., 1911.
" "	A. T. Adele	20	... ...	" " 16.11.11...	16th Nov., 1911.
" "	R. C. Porter	—	... ...	Probation	2nd Jan., 1911.
" "	J. A. S. Cole	—	... ...	"	" " "
" "	J. G. Cole	—	... ...	"	" " "
" "	Y. A. Fahn	—	... ...	"	" " "
" "	G. Johnson	—	... ...	"	" " "
" "	A. Kemavov	—	... ...	"	" " "
Pupil Draughtsman	W. A. Hollist	9	... ...	"	1st Oct., 1911.
" "	A. R. Balogun	9	... ...	"	" " "

UGANDA.					
Director of Surveys	Mr. R. C. Allen	500–700, by £25.	... ...	... ...	23rd Nov., 1900.
Deputy Director of Surveys ...	Mr. W. V. Morris	325–425, by £20.	£75 personal ...	... ...	27th July, 1902.
District Surveyor	Mr. E. Richardson	360–20–400	... ...	3 years' agreement (Re-engaged for 3 years).	8th April, 1904.
,, ,, ...	Mr. E. G. Fenning	360–20–400	... ...	3 years' agreement (Re-engaged).	18th April, 1904.
,, ,, ...	Mr. L. R. Fraser	360–20–400	... ...	,, ,, ,,	18th April, 1904.
,, ,, ...	Mr. H. Boazman	350	... ...	,, ,, ,,	27th March, 1907.
Senior Staff Surveyor ...	Mr. J. P. Tolland	300–20–340	... ...	,, ,, ,,	8th Dec., 1909.
Junior Staff Surveyor ...	Mr. A. Richardson	300	... ...	3 years' agreement (Re-engaged for 30 months).	1st June, 1903.
,, ,, ,, ...	Mr. J. T. W. S. McGregor ...	300	... ...	3 years' agreement (Re-engaged for 3 years).	17th July, 1903.
,, ,, ,, ...	Mr. A. H. Gee	300	... ...	3 years' agreement from date of arrival in Africa (not reported).	23rd March, 1907.
,, ,, ,, ...	Vacant	... ...	... ...	,, ,, ,,	—
Survey Probationers	Mr. J. G. Strickland	250–15–280	... ...	... ...	4th Nov., 1910.
,, ,, ...	Mr. J. Brown	250–15–280	... ...	... ...	14th Sept., 1911.
,, ,, ...	Mr. H. B. Thomas	250–15–280	... ...	... ...	9th Nov., 1911.
,, ,, ...	Vacant	250–15–280	... ...	... ...	—
Indian Assistant Surveyor ...	Wahid Ali Khan, K.B. ...	300	... ...	... ...	27th March, 1901.
Head Clerk and Storekeeper...	Mr. W. L. Freemantle... ...	180–10–200	... ...	... ...	22nd July, 1908.
Draughtsman	Mr. F. C. Macdonald	180–10–200	... ...	... ...	22nd July, 1910.
NYASALAND.					
Director of Public Works ...	Mr. T. I. Binnie	450–600, by £25.	£100 personal ...	Permanent	15th March, 1897.
Assistant Director of Public Works.	Mr. T. J. Firr	325–425, by £25.	£12 10*s.* electric light.	,, ...	26th April, 1902.
Assistant Surveyor	Mr. J. Bannerman	325–425, by £20.	,, ,, ,,	,, ...	1st June, 1901.

Office.	Name.	Salary. £	Allowances.	Tenure of Appointment.	Date of present Appointment.
		JAMAICA.			
Surveyor-General	Mr. Colin Liddell	500	Actual travelling expenses.	Permanent	1st Oct., 1890.
Assistant Surveyor	Mr. W. A. Baker	300	" " "	"	1st April, 1903.
" "	Mr. H. D. Rogers	250	" " "	Temporary	17th April, 1905.
2nd Class Clerk	Mr. E. G. Wilson	170	... ...	Permanent	1st Mar., 1893.
Assistant Clerk	Mr. V. N. Smith	94	... ...	Temporary	19th Feb., 1909.
Typist	Mr. A. R. Munn	60	... ...	"	6th July, 1910.
Clerk	Mr. K. L. Fiddes	60	... ...	"	1st May, 1911.
		TRINIDAD.			
		Crown Lands Branch.			
Engineer in Charge of Surveys	Mr. E. R. Smart	500	£100 travelling allowance.	... ...	1st June, 1910.
1st Assistant	Mr. R. Kernahan	350	" " "	... ...	1st Jan., 1898.
2nd "	Mr J. W. Dumanoire	250	" " "	... ...	10th Nov., 1903.
1st Draughtsman	Mr. T. Sorzano	225	£75 personal allowance.	... ...	18th July, 1874.
2nd "	Mr. Th. Sorzano	150	... ...	... ...	12th Nov., 1881.
3rd "	Mr. F. Sorzano	125	... ...	... ...	1st April, 1907.
4th "	Mr. F. Dumanoire	80	... ...	... ...	1st Aug., 1910.
Clerk	Mr. A. W. Hunt	100	... ...	... ...	15th May, 1901.

Office.	Name.	Salary.	Date of First Appointment.
	BRITISH HONDURAS.		
		$	
Surveyor-General ...	Mr. H. I. Perkins, I.S.O.	3,402	18th Oct., 1905.
Assist. Surveyor-General	Mr. W. H. Carlin ...	1,944	1st April, 1896.
Assistant Surveyor ...			
" " ...	Mr. F. W. Brunton ...	1,458	18th Nov., 1903.
" " ...	Mr. C. la T. Franks, B.A.	1,458	25th Feb., 1907.
" " ...	Mr. L. E. Williams ...	1,458	1st Jan., 1906.
Temporary Surveyor ...	Mr. C. L. Ridley ...	1,458	1st Jan., 1909.
Forest Officer	Mr. J. L. Brown ...	600-60-900	1st June, 1896.
" "	Mr. G. Hulse	600-60-840	1st Jan., 1910.
1st Class Clerk	Mr. D. Rosado	720-40-960	16th May, 1907.
Tracer	Mr. I. C. Hulse... ...	360-20-480	1st May, 1911.
	CEYLON.		
Surveyor-General ...	*Mr. R. S. Templeton ...	Rs.13,500-16,875†	15th Oct., 1887.
		£	
Deputy Surveyor-General	*Mr. W. C. S. Ingles ...	700-50-800	4th Jan., 1890.
Assistant " "	*Mr. H. O. Barnard ...	700-50-800	4th Dec., 1890.
Superintendent, Application Surveys.	*Mr. A. J. Wickwar ...	500-25-600	1st Sept., 1889.
Superintendent, Waste Lands Surveys.	Mr. A. H. G. Dawson ...	500-25-600	16th Dec., 1895.
		£	
Superintendent of Surveys.	*Mr. L. Shipton ...	500-25-600	4th Sept., 1884.
" " "	*Mr. H. Erskine ...	500-25-600	1st Mar., 1876.
" " "	*Mr. C. F. W. Halliley...	400-25-450	1st Mar., 1891.
" " "	*Mr. C. R. Lundie ...	400-25-450	13th Feb., 1904.
" " "	Mr. A. J. Stronach ...	400-25-450	30th June, 1906.
" " "	*Mr. D. Bloxham ...	400-25-450	5th Oct., 1907.
" " "	*Mr. G. K. Thornhill ...	400-25-450	15th July, 1901.
Assistant Superintendent of Surveys.	*Mr. J. W. Robertson ...	300-25-350	17th June, 1885.
" " "	*Mr. A. E. Dirckze ...	300-25-350	1st Oct., 1889.
" " "	*Mr. C. H. Vince ...	300-25-350	13th June, 1908.
" " "	*Mr. F. J. Salmon ...	300-25-350	13th June, 1908.
" " "	*Mr. L. G. O. Woodhouse	300-25-350	1st Aug., 1905.
" " "	*Vacant	300-25-350	—
" " "	Mr. H. M. C. Ledger ..	300-25-350	13th June, 1908.
" " "	Mr. E. B. Manson ...	300-25-350	13th June, 1908.
" " "	Mr. R. W. E. Ruddock...	300-25-350	5th Nov., 1908.
" " "	Mr. P. J. May	300-25-350	6th May, 1909.
" " "	Mr. N. B. Favell ...	300-25-350	6th May, 1909.
" " "	Mr. F. L. Baker ...	300-25-350	6th May, 1909.
" " "	Mr. K. W. S. Mitchell...	300-25-350	6th May, 1909.
" " "	Mr. H. P. Harrison ...	300-25-350	20th May, 1909.
" " "	Mr. B. C. Johnstone ...	300-25-350	21st Oct., 1909.
" " "	Mr. G. B. Manson ...	250	4th Nov., 1911.
" " "	Mr. L. E. S. Mitchell ...	250	4th Nov., 1911.
" " "	Mr. H. O. Clark ...	300-25-350	21st Oct., 1909.
" " "	Mr. C. C. S. Stephenson	300-25-350	21st Oct., 1909.
" " "	Mr. B. S. Coventry ...	300-25-350	19th Nov., 1909.
" " "		300-25-350	15th Jan., 1910
" " "	Mr. P. E. L. Gethin ...	300-25-350	1st April, 1910
" " "	Mr. W. Adam	250	20th Jan., 1912.

* Permanent appointment.
† By biennial increments of Rs. 1,125.

Office.	Name.	Salary.	Date of First Appointment.
	CEYLON—*cont.*		
		£	
Assistant Superintendent of Surveys. (Field Staff.)	Mr. T. Easten	250	11th Aug. 1911.
" " "	L.-Corpl. F. E. Dainty...	250–10–300	5th June, 1908.
" " "	Sapper G. A. Robertson	250–10–300	5th June, 1908.
Assistant Superintendent of Surveys. (Office Staff.)	Mr. W. W. A. Wall ...	300-10-350	5th Nov., 1908.
" " "	Sergt. H. W. Johnson...	300–10–350	22nd May, 1908.
" " "	Corpl. E. E. O'Leary ...	300–10–350	22nd May, 1908.
" " "	Corpl. W. F. Hawkesworth.	300–10–350	18th June, 1909.
" " "	Corpl. W. S. Maddams ...	300–10–350	18th June, 1909.
" " "	Corpl. R. B. Crusher ...	300–10–350	18th June, 1909.
" " "	Sergt. A. Plested ...	300–10–350	9th Sept., 1910.
Assistant Astronomer ...	Mr. A. J. Bamford ...	350–25–500	31st Oct., 1908.
Accountant	Mr. W. C. H. Tripp ...	400–25–500	15th July, 1911.
	FEDERATED MALAY STATES (1st Jan. 1912).		
Surveyor General ...	*Col H. M. Jackson (late R.E.).	1,200	28th Aug., 1908.
	Trigonometrical Branch.		
Deputy Surveyor General	*Mr. A. E. Young ...	780–900	28th June, 1902.
Assistant Superintendents	*Mr. W. A. Wallace ...	480–540	8th Feb., 1904.
	*Mr. F. R. Twiss ...	480–540	21st June, 1906.
Surveyors, Grade I. ...	Mr. V. A. Lowinger ...	360–480	10th Aug., 1906.
	Mr. R. R. Goulding ...	360–480	25th May, 1907.
	Mr. A. Cochrane ...	360–480	30th Nov., 1907.
" (on agreement)	Mr. W. A. D. Edwards...	420	1st May, 1911.
	Mr. J. C. Wood ...	420	8th Feb., 1911.
" Probationer...	Mr. C. A. Rust	275	19th Nov., 1910.
	Topographical Branch.		
Superintendent	*Mr. E. W. Hedgeland	650–800	3rd Jan., 1907.
Assistant Superintendent	*Mr. J. N. Sheffield ...	480–540	14th Sept., 1906.
Surveyors...	Mr. J. R. Newland ...	360–480	1st Jan., 1911.
	Mr. J. H. Williams ...	360–480	1st June, 1911.
" Probationers...	Mr. H. C. Abrahams ...	275	28th Jan., 1911.
	Mr. C. S. Wood... ...	275	8th Sept., 1911.
	Mr. C. St. L. Perfect ...	275	Oct., 1911.
	Revenue Survey Branch.		
	PERAK.		
Superintendent	*Mr. J. P. Harper ...	650–800	2nd Sept., 1889.
Deputy Superintendent	*Mr. L. U. Stafford ...	540–600	1st Sept., 1900.
Assistant Superintendents—			
District Surveyors ...	*Mr. E. G. Wood ...	480–540	21st Dec., 1889.
	*Mr. A. A. Campbell ...	480–540	15th June, 1902.
	*Mr. J. Bowes	480–540	18th Jan., 1902.
	*Mr. G. A. Hodges ...	480–540	1st July, 1901.
	*Mr. R. L. Buckwell ...	480–540	30th April, 1904.
(Office—Perak) ...	*Mr. F. A. Sugden ...	360–480	10th May, 1901.
(Office—Kinta) ...	*Mr. R. Gillett	360–480	17th Aug., 1903.
Surveyors Grade I. ...	*Mr. F. B. Sewell ...	360–480	3rd Oct., 1906.
	*Mr. W. A. Gummer ...	360–480	1st Nov., 1907.
	*Mr. R. V. Morris ...	360–480	22nd Feb., 1908.

* Permanent appointment.

Office.	Name.	Salary.	Date of First Appointment.
	FEDERATED MALAY STATES—*cont.*		
	***Revenue Survey Branch*—cont.**		
	PERAK—*cont.*		
		£	
Surveyors (on agreement).	Mr. C. Y. Sewell ...	420	7th Oct., 1908.
	Mr. A. C. Every ...	420	9th Aug., 1910.
	Mr. H. J. Twamley ...	420	6th Sept., 1910.
	Mr. W. Whittingdale ...	420	
	Mr. W. T. S. Deacon ...	420	, 1911.
	Mr. J. W. Stack ...	420	, 1911.
„ Probationer ...	Mr. C. S. Durst ...	275	23rd Sept., 1911.
	SELANGOR.		
Superintendent	*Mr. H. R. Shaw ...	650–800	27th June, 1890.
Assistant Superintendents—			
District Surveyors ...	*Mr. C. J. Perkins ...	480–540	8th Feb., 1904.
	*Mr. F. J. Gore... ...	480–540	23rd Jan., 1904.
	Mr. N. F. Haszard ...	480–540	
	*Mr. D. S. Richards ...	480–540	27th May, 1904.
Surveyors, Grade I. ...	*Mr. O. E. Jansz ...	360–480	1st July, 1903.
	Mr. J. W. Johnston ...	360–480	18th Oct., 1906.
„ (on agreement)	Mr. N. W. Jarvis ...	420	9th Aug., 1910.
	Mr. A. de T. Joubert ...	420	7th Sept., 1910.
	Mr. J. A. Simpson ...	420	9th May, 1911.
	Mr. N. E. Beckman ...	420	
„ Probationer ...	Mr. H. L. Penfold ...	275	28th Jan., 1911.
	NEGRI SEMBILAN.		
Superintendent	*Mr. C. M. Goodyear ...	650–800	1st May, 1902.
Assistant Superintendents—			
District Surveyor ...	*Mr. E. Sweney ...	480–540	22nd Sept., 1898.
	*Mr. E. W. Geyer ...	480–540	4th Feb., 1902.
	*Mr. E. E. P. Clare ...	480–540	1st May, 1899.
	*Mr. H. J. Mackenzie ...	480–540	25th June, 1904.
Office	*Mr. W. H. Hanson ...	360–480	11th Nov., 1904.
Surveyors, Grade I. ...	*Mr. E. C. Dew... ...	360–480	7th Mar., 1904.
	*Mr. A. P. Schreiber ...	360–480	3rd Jan., 1908.
„ (on agreement)	Mr. W. N. Horne ...	420	4th Mar., 1908.
	Mr. W. J. C. Stevens ...	420	4th June, 1909.
	Mr. F. M. Battye ...	420	4th Feb., 1911.
	Mr. J. T. Wood... ...	420	30th Jan., 1909.
„ Probationer ...	Mr. L. M. Davenport ...	275	28th Jan., 1911.
	PAHANG.		
Superintendent	*Mr. E. J. Kemplen ...	650–800	18th Dec., 1891.
Assistant Superintendents—			
District Surveyor ...	*Mr. T. Le Fevre ...	480–540	1st Aug., 1902.
Office	*Mr. A. B. Allen ...	360–480	9th Oct., 1911.
Surveyors, Grade I. ...	*Mr. E. Aune	360–480	8th June, 1909.
	*Mr. J. Renton... ...	360–480	June, 1911.
„ (on agreement)	Mr. R. M. M. Carson ...	420	, 1911.
	Mr. E. A. Kenny ...	420	, 1911.
„ Probationer ...	Mr. F. R. Whitten ...	275	22nd Sept., 1911.

* Permanent appointment.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

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711	Leeward Islands	"
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713	St. Lucia	1910
714	St. Helena	1911
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716	Ceylon	1910–1911
717	Gibraltar	1911
718	Gambia	"
719	Ashanti	"
720	Falkland Islands	"
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723	Hong Kong	"
724	Sierra Leone	"
725	Gold Coast	"
726	Turks and Caicos Islands	"
727	Fiji	"
728	Bechuanaland Protectorate	"
729	Basutoland	1911–1912
		"

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No.	Colony, &c.	Subject.
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72	Fiji	Hurricane, 1910.
73	Jamaica	Cayman Islands.
74	Ceylon	Mineral Survey, 1906–7 and 1907–8.
75	West Indies	Imperial Department of Agriculture.
76	Southern Nigeria	Mineral Survey, 1907–8.
77	St. Vincent	Roads and Land Settlement Fund.
78	Weihaiwei	Census, 1911.
79	Northern Nigeria	Mineral Survey, 1907–8 and 1908–9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.

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COLONIAL REPORTS—ANNUAL.

No. 775.

THE SURVEYS

OF

BRITISH AFRICA, BRITISH HONDURAS, CEYLON, CYPRUS, FIJI, HONG KONG, JAMAICA, MALAY STATES AND TRINIDAD

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

EIGHTH YEAR.

To 31st March, 1913.

(For Report for 1911–12, *see* No. 730.)

Presented to both Houses of Parliament by Command of His Majesty.
November, 1913.

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By DARLING AND SON, LTD., BACON STREET, E.

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No. 775.

COLONIAL SURVEY COMMITTEE REPORT.

FOR THE YEAR ENDING 31ST MARCH, 1913

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

H. J. READ.
C. F. CLOSE, *Colonel, D.G.O.S.*
W. C. HEDLEY, *Lt.-Col., Gen. Staff.*

W. C. BOTTOMLEY,
E. W. COX, } *Secretaries.*
Captain, G.S.

September, 1913.

[NOTE.—During the year under review the scope of the Committee was extended to include geological surveys in British Colonies and Protectorates, and Dr. J. J. H. Teall, F.R.S., F.G.S. (Director, Geological Survey of the United Kingdom), Dr. J. W. Evans, F.G.S. (Imperial Institute), and Mr. J. F. N. Green (Colonial Office) were appointed members. As, however, no material relating to geological surveys was received in the year, the present report is confined to the progress of the land surveys, and has not been signed by the newly appointed members.]

(31410—2.) Wt. 35104—688. 1125 & 90. 11/13. D & S. A 2

I.

REVIEW OF SURVEY WORK IN AFRICA DURING THE PAST YEAR.

A.—In British Possessions.

Topographical Surveys.—Some 27,500 square miles have been surveyed on topographical scales. This is 2,500 square miles less than the area surveyed during the previous year, the decrease being due to the completion of the Orange Free State survey and the closing down of the surveys in the Cape of Good Hope and the Transvaal.

The more important areas that have been surveyed during the past year are :—

East Africa Protectorate	11,688 sq. miles.
Southern Nigeria	5,998 " "
Gold Coast	4,634 " "
Uganda	1,071 " "
Boundary Commissions...	4,000 " "

Topographical Maps Published.—The following maps have been published since the last report of the Colonial Survey Committee :—

East Africa Protectorate	$\frac{1}{250000}$ (provisional series)	4 sheets.
" " "	$\frac{1}{125000}$	3 "
Southern Nigeria ...	$\frac{1}{125000}$ (standard sheets) ...	3 "
" " ...	$\frac{1}{125000}$ (provisional series)	2 "
Cape of Good Hope ...	$\frac{1}{250000}$	4 "
Pemba Island	1-inch	2 "
Anglo-German and Anglo-Belgian Boundaries (Mfumbiro region).	$\frac{1}{200000}$	2 "

For particulars of the above sheets see the more detailed reports of the surveys of British Africa.

There have also been published three "compiled" sheets of Sierra Leone, on the scale of $\frac{1}{250000}$.

The following small-scale maps have also been published :—

Anglo-Portuguese Boundaries North and South of the Zambesi, $\frac{1}{1000000}$.

Gold Coast, Ashanti and Northern Territories, $\frac{1}{1500000}$.

Mombasa-Victoria (Uganda) Railway and Busoga Railway, $\frac{1}{1500000}$.

Cadastral Surveys have been continued in East Africa, Gold Coast, Southern Nigeria, Nyasaland and Uganda, and fresh cadastral surveys have been begun in Northern Nigeria.

Boundary Commissions.—

(i) The Anglo-Belgian (Rhodesia-Congo) Boundary Commission finished the survey of the area south of Lake Bangweolo, and carried triangulation along the Congo-Zambesi watershed as far as longitude 26° 15′ E.

The Commission has now been divided into two sections. The Rhodesia-Katanga section, which is to work up to the 24th meridian E. of Greenwich, will probably return to England in the autumn of 1914, while the Tanganyika-Mweru section is expected to finish in the field by November, 1913.

(ii) Towards the end of 1911 the Sierra Leone-French Guinea boundary was modified, a natural frontier being substituted for the 13th meridian W. of Paris.

In July, 1912, two local commissioners signed a new *procès-verbal* defining the boundary from Tembikunda to the junction of the Moa and Dandogbia rivers, where the Sierra Leone-French Guinea and Liberian boundaries meet.

(iii) In July, 1912, was signed the *procès-verbal* defining the Nigeria-Dahomey boundary from the Gulf of Guinea to the Okpara river.

(iv) A Commission left England in August, 1912, to beacon the Nigeria-Cameroon (Yola-Cross River) boundary. The work is finished.

(v) In December, 1912, a small Commission assembled near Mahagi, on the north-west shore of Lake Albert, to survey the Uganda-Belgian Congo boundary between Lake Albert and the Congo-Nile watershed. The work is finished and the recommendations as to the frontier to be adopted have reached England.

(vi) In February, 1913, local commissioners in Sierra Leone made another attempt to delimit the Anglo-Liberian boundary, as defined in the convention of January 21st, 1911, between the Moa and the Mauwa rivers.

(vii) In March, 1913, the Anglo-Portuguese Boundary Commission left England for the northern end of the Rhodesia-Angola frontier.

B.—In Foreign Possessions.

Systematic surveys have been continued in French Morocco, Algeria, Tunis, Cameroon, German South-West Africa and German East Africa, and the Italians have begun fresh surveys in Tripoli, eastwards from the French frontier, and in Italian Somaliland.

During the period March, 1912, to March, 1913, the following topographical maps were published :—

French Morocco,	$\frac{1}{100000}$	... ...	5 sheets.
„ „	$\frac{1}{200000}$	... ...	12 „
Algeria,	$\frac{1}{200000}$	... ...	1 sheet.
Tunis,	$\frac{1}{50000}$	... ...	1 „
„	$\frac{1}{100000}$	... ...	15 sheets.
Italian Somaliland,	$\frac{1}{50000}$	... ...	1 sheet.
„ „	$\frac{1}{100000}$	... ...	1 „
„ „	$\frac{1}{200000}$	... ...	3 sheets.

There have also been published 16 "compiled" sheets of Cameroon, on the scale of $\frac{1}{300000}$.

Diagram I. shows the state of surveys in Africa at the present time. It will be seen that, although large areas of British territory have been systematically surveyed, there is still much to be done. Even in the more highly developed countries, such as the Cape of Good Hope and the Transvaal, there are large areas of which no reliable topographical map has been made, while practically the whole of Natal is still to be mapped.

II.

REGULATIONS AFFECTING SURVEY DEPARTMENTS.

Memorandum on Colonial Survey Appointments.

Note.—These regulations supersede those contained in the last report and are subject to revision from time to time.

The Secretary of State for the Colonies has approved of the following arrangements for the selection of candidates for junior survey appointments in Crown Colonies and Protectorates.

1. For the purpose of selecting surveyors, Ceylon, the Federated Malay States, and the East Africa* and Uganda Protectorates will be grouped, and candidates will be required to pass the same tests and go through the same preliminary training. Candidates will, however, be allowed to indicate their preference for particular Colonies, and, if they wish it, to await the occurrence of vacancies. It is possible† that other Colonies or Protectorates may be included in these arrangements in the future, but for the present they will apply only to the countries named, which are those in which vacancies may be expected to occur most frequently.

2. Candidates must be between the ages of 21 and 27 and should be unmarried, as the conditions of service for surveyors in the countries concerned are not suitable for a married man.

3. Anyone wishing to become a candidate for these posts should apply in writing to the Private Secretary to the Secretary of State, Colonial Office, London, S.W. He will be required to fill in a form of application and to furnish testimonials and the names of two referees. If the information thus obtained is considered satisfactory, he will be asked to call at the Colonial Office for a personal interview, and, if accepted, will be nominated as a candidate.

4. A candidate not exempted under paragraphs 5 or 6 of this Memorandum will be required to pass two tests :—

(*a.*) A qualifying examination in mathematics, including algebra, geometry, and plane trigonometry ; and

(*b*) An oral qualifying examination in the use and adjustment of surveying instruments.

The candidate will be required to pay a fee of one guinea for each examination.

5. A candidate who has passed with honours in mathematics, physical science, or engineering, or who has obtained an equivalent diploma or distinction in a University or School of a University in the United Kingdom, or who has been licensed to practise as a surveyor in one of His Majesty's Dominions, or has obtained the surveying diploma of the Royal Geographical Society, will not be required to undergo any technical or educational test.

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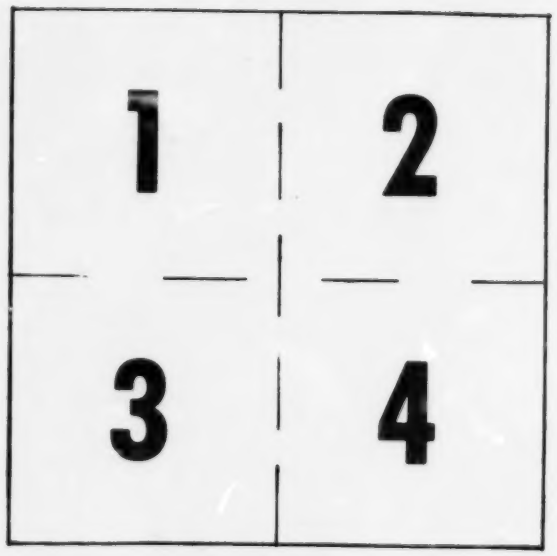
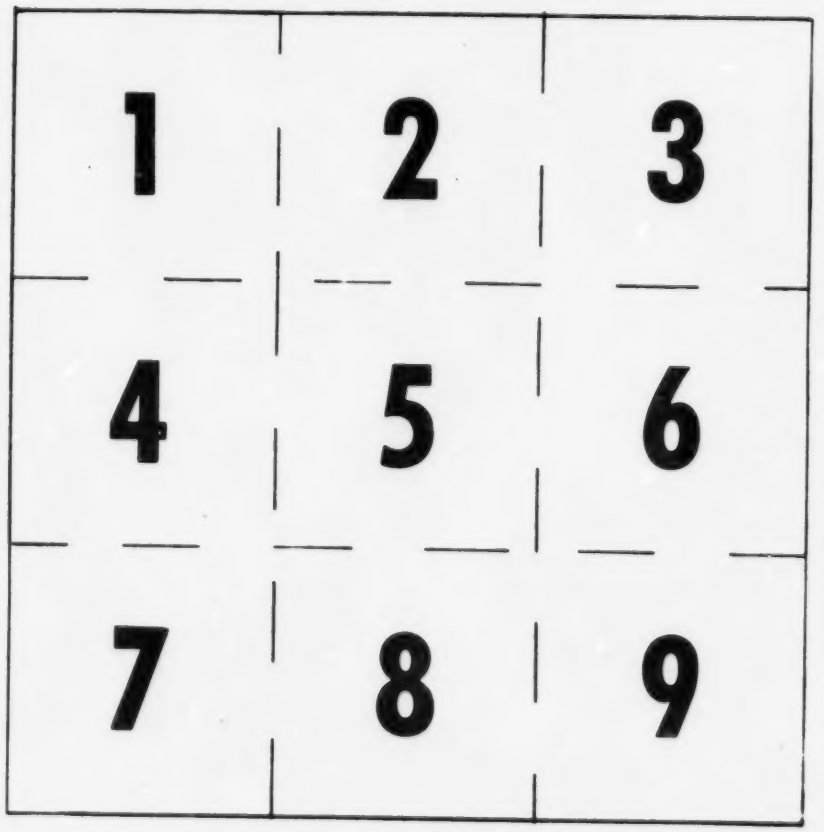
* The extent to which the arrangements can be applied to the East Africa Protectorate is at present uncertain.

† The extension of the arrangements to Northern Nigeria is now in prospect, but no definite information of the conditions which will apply in that case can yet be issued.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





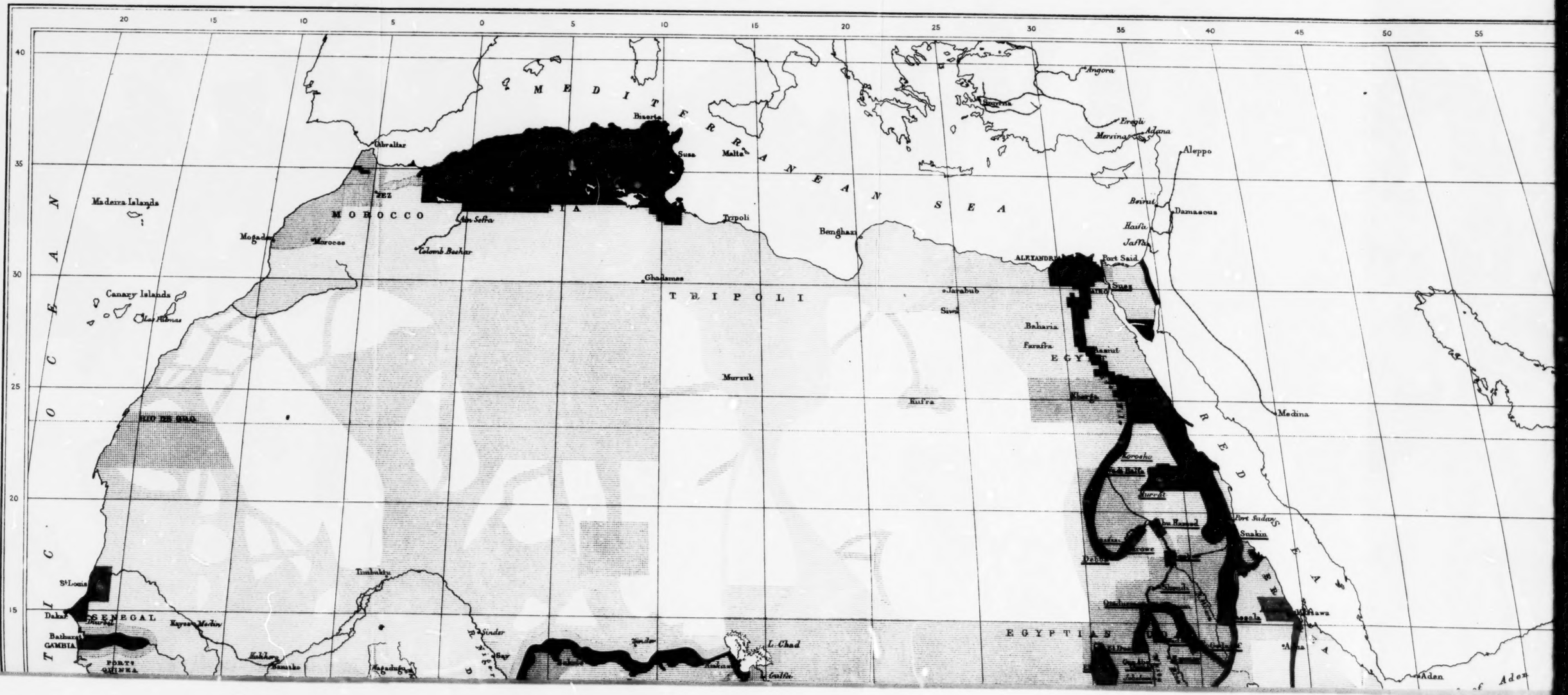
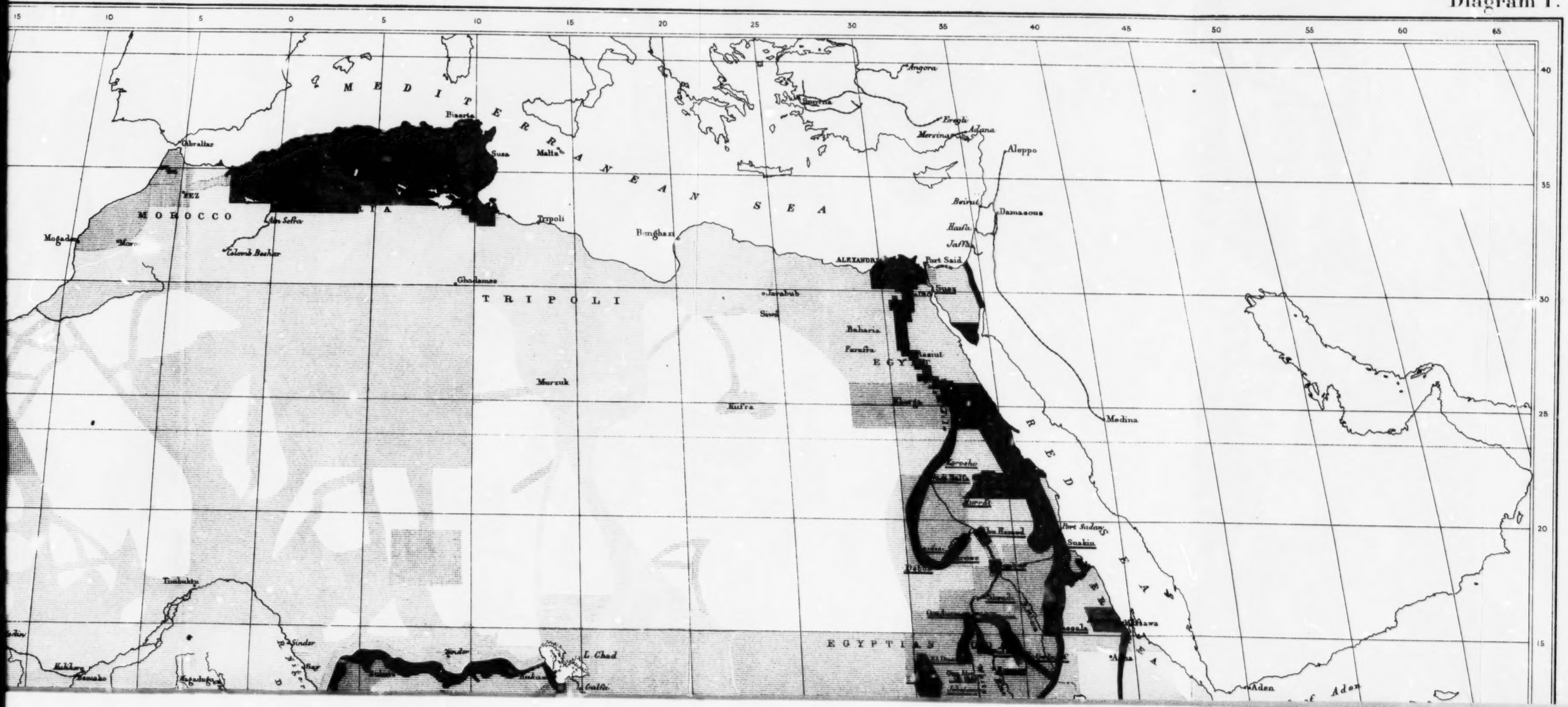

MEDITERRANEAN SEA
ATLANTIC OCEAN
RED SEA
MOROCCO
FEZ
Madeira Islands
Canary Islands
Las Palmas
Mogador
Morocco
Abo Seffra
Colomb Bechar
Gibraltar
Bizerta
Susa
Malta
Tripoli
Benghazi
Ghadames
TRIPOLI
Jarabub
Siwa
Angora
Brousa
Eregli
Mersina
Adana
Aleppo
Beirut
Damascus
Haifa
Jaffa
ALEXANDRIA
Port Said
Suez
CAIRO
Baharia
Farafra
EGYPT
Asiut
Kharga
Murzuk
Kufra
Medina
Koroska
Berber
Suakin
Port Sudan
Abu Hamed
Dongola
Sennaar
Halfaya
Aden
RIO DE ORO
St Louis
Dakar
Bathurst
GAMBIA
SENEGAL
Bissao
PORTS GUINEA
Timbuktu
Kayes
Medine
Kakkora
Sansanko
Sinder
Kuka
L. Chad
Gulfei
EGYPTIAN

Diagram 1.


MEDITERRANEAN SEA
MOROCCO
FEZ
TRIPOLI
EGYPT
EGYPTIAN
RED SEA
Gibraltar
Bizerta
Suza
Malta
Tripoli
Benghazi
Angora
Smyrna
Eregli
Mersina
Adana
Aleppo
Beirut
Damascus
Haifa
Jaffa
ALEXANDRIA
Port Said
SUEZ
Jarabub
Siwa
Baharia
Farafra
Kasr el Dakhel
Kharga
Assiut
Murzuk
Kaffra
Ghadames
Mogador
Marocco
Akabah
Medina
Yenbo
Kosseir
Port Sudan
Suakin
Timbuktu
Sinder
Kong
Kokhoro
Bamako
Sego
Sokadoo
Sokoto
Yoruba
L. Chad
Kuka
Aden
Hodeida
Mocha

MAP OF AFRICA

to illustrate the progress of surveys and explorations

REFERENCE

Surveys which may be taken as exact for reproduction on the scale of 250000

British & Egyptian Territory

Foreign Territory

ATLANTIC OCEAN

INDIAN OCEAN

SENEGAL

FRENCH GUINEA

PORTUGUESE GUINEA

GAMBIA

LIBERIA

IVORY COAST

GOLD COAST

TOGOLAND

DAHOMEY

NIGERIA

CAMEROONS

GULF OF GUINEA

FRENCH CONGO

BELGIAN CONGO

UPPER UBANGI

EGYPTIAN SUDAN

ABYSSINIA

FRENCH SOMALILAND

SOMALILAND PROTECTORATE

ITALIAN SOMALILAND

GULF OF ADEN

RED SEA

EAST AFRICA PROTECTORATE

GERMAN EAST AFRICA

PORTUGUESE EAST AFRICA

ANGOLA

NORTH WESTERN RHODESIA

NORTH EASTERN RHODESIA

SOUTHERN RHODESIA

BECHUANALAND

DAGASCAR

COMORO IS

MOMBASA

ZANZIBAR

DAR ES SALAAM

MOZAMBIQUE

Timbuktu

St Louis

Dakar

Bathurst

Freetown

Monrovia

Grand Bassam

Salaga

Accra

Lagos

Porto Novo

Benin

Kano

Zaria

Lokoja

Ibi

Yola

L. Chad

Bonga

Fernando Po

Princes Is

St Thomas

Libreville

Gaboon

Coquilhatville

Stanleyville

Stanley Falls

Ponthierville

Brazzaville

Leopoldville

R. Congo

R. Kasai

R. Lomami

Nyangwe

Kindu

S. Paul de Loanda

Malange

Lobito B

Benguela

Mossamedes

Walvis B

Gt Namaqua Land

Great Fish R

Orange R

Bloemfontein

Kimberley

Mafeking

Buluwayo

Gwelo

Salisbury

Umtali

Beira

Sofala

Inhambane

Lourenco Marques

Delagoa B

Chande

Inhamane

Quelimane

Port Herald

Fort Johnston

Lake Nyasa

R. Zambesi

R. Shire

Tete

Mlanje

Tabora

Mpwapwa

Kilwa

Lindi

Mikindani

Kismayu

Mogdishu

Juba

Wadelai

Victoria Nyanza

L. Albert

L. Edward

Lake Tanganyika

Kivu

Mahagi

Port Sudan

Suakin

Berbera

Zeila

Harrar

Jibuti

Aden

Obock

Taka

Kassala

Gondokoro

Deim Zubeir

Meshra el Rek

Bahr el Ghazal

Bahr el Jebel

Wau

Rumbek

Fashoda

Khartoum

Berber

Dongola

Abu Hamed

Merawi

Wadi Halfa

Assuan

Assiut

Cairo

Suez

Port Said

Alexandria

Tripoli

Ghadames

Murzuk

Tibesti

Kufra

Tummo

Uweinat

Darfur

Kordofan

Sennar

Fazogl

Kassala

Gallabat

Massawa

Asmara

Adowa

Adigrat

Axum

Makalle

Magdala

Lake Tsana

Gondar

Debra Tabor

Debra Markos

Addis Abeba

Harar

Ankober

Sokoto

Kano

Zaria

Bida

Nupe

Ilorin

Abeokuta

Lagos

Porto Novo

Benin

Old Calabar

Bonny

Victoria

Akasa

Duala

Kribi

Batanga

Gaboon

Cape Lopez

Cape St Mary

Cape Palmas

Cape Mount

Sierra Leone

Freetown

Conakry

Boke

Timbo

Kankan

Siguiri

Bissau

Bathurst

Kayes

Medine

Bakel

Senegal R

Niger R

Benue R

Volta R

Gambia R

Kolente R

Rokelle R

Sherbro I

Bonny R

Old Calabar R

Cross R

Kwa R

Sanaga R

Ogowe R

Kuilu R

Congo R

Kasai R

Lomami R

Lualaba R

Aruwimi R

Ubangi R

Shari R

Logone R

Nile

Atbara R

Blue Nile

White Nile

Sobat R

Juba R

Tana R

Webi Shebeli R

Limpopo R

Pungwe R

Buzi R

Sabi R

Save R

Rovuma R

Shire R

Zambesi R

Kafue R

Luangwa R

Loangwa R

Kunene R

Okavango R

Zambesi R

Kasai R

Lomami R

Lualaba R

Aruwimi R

Ubangi R

Shari R

Logone R

Nile

Atbara R

Blue Nile

White Nile

Sobat R

Juba R

Tana R

Webi Shebeli R

Limpopo R

Pungwe R

Buzi R

Sabi R

Save R

Rovuma R

Shire R

Zambesi R

Kafue R

Luangwa R

Loangwa R

Kunene R

Okavango R

MAP OF AFRICA

To illustrate the progress of surveys and explorations

REFERENCE

British & Egyptian Territory

Foreign Territory

... may be taken as exact for ... on the scale of 250,000.....

EGYPTIAN SUDAN

NIGERIA

TOGO LAND

IVORY COAST

GOLD COAST

DAHOMEY

CAMEROONS

UPPER UBANGI

FRENCH CONGO

BELGIAN CONGO

ANGOLA

NORTH WESTERN RHODESIA

SOUTH WESTERN RHODESIA

BECHUANALAND

PORTUGUESE EAST AFRICA

GERMAN EAST AFRICA

BRITISH EAST AFRICA PROTECTORATE

ABYSSINIA

ITALIAN SOMALILAND

FRENCH SOMALI LAND

Gulf of Guinea

Gulf of Aden

Red Sea

Indian Ocean

Madagascar

Timbuktu

Port Sudan

Suakin

Aden

Zeila

Harrar

Berbera

Obock

Jibuti

Kano

Sokoto

Lagos

Accra

Sekondi

C. Palmas

C. Bassam

Fernando Po

Princes I.

St Thomas

Libreville

Loango

Brazzaville

Leopoldville

Matadi

S. Paul de Loanda

Benguela

Lobito B.

Mossamedes

Lake Chad

Yola

Bornu

Zaria

Kuka

Ibi

Abeokuta

Porto Novo

Benin

Bonny

Victoria

Calabar

Akassa

Old Calabar

Duma Zubeir

Wau

Rumbek

Bor

Gondokoro

Wadelai

Lake Albert

Lake Edward

Lake Victoria Nyanza

Stanleyville

Stanley Falls

Coquilhatville

Pontnierville

R. Congo

R. Ubangi

R. Kasai

Nyangwe

Kindu

Tabora

Mpwapwa

Zanzibar

Dar es Salaam

Mombasa

Kismayu

Lamu

Mogdishu

Langenburg

Lindi

Nkata

Lake Nyasa

Lake Bangweolo

Lake Mweru

Lake Tanganyika

Kafue

Victoria Falls

Zambesi

R. Shire

Mt. Shirwa

Mt. Johnston

Port Herald

Blantyre

Chinde

Beira

Sofala

Inhambane

Mozambique

Quelimane

Tete

Comoro Is.

Abo

Zomba

Salisbury

Gwelo

Bulawayo

Victoria

Buluwayo

Tati

Francistown

Palapye Road

Mafeking

Kimberley

Pretoria

Johannesburg

Durban

Port Elizabeth

Cape Town

Walvisch B.

Walfisch B.

Damaraland

Ovampo

Kaffraria

Basutoland

Orange Free State

Transvaal

Natal

Cape Colony

Zululand

Swaziland

Delagoa Bay

Lourenco Marques

Malange

Mossamedes

Lobito B.

Benguela

Timbuktu

Sinder

R. Niger

R. Benue

R. Shari

R. Nile

R. Atbara

R. Blue Nile

R. White Nile

R. Sobat

R. Juba

R. Tana

R. Limpopo

R. Orange

R. Vaal

R. Kafue

R. Zambesi

R. Shire

R. Congo

R. Ubangi

R. Kasai

R. Niger

R. Benue

R. Shari

R. Nile

R. Atbara

R. Blue Nile

R. White Nile

R. Sobat

R. Juba

R. Tana

R. Limpopo

R. Orange

R. Vaal

R. Kafue

R. Zambesi

R. Shire

R. Congo

R. Ubangi

R. Kasai

R. Niger

R. Benue

R. Shari

R. Nile

R. Atbara

R. Blue Nile

R. White Nile

R. Sobat

R. Juba

R. Tana

R. Limpopo

R. Orange

R. Vaal

R. Kafue

R. Zambesi

R. Shire

OF

AFRICA

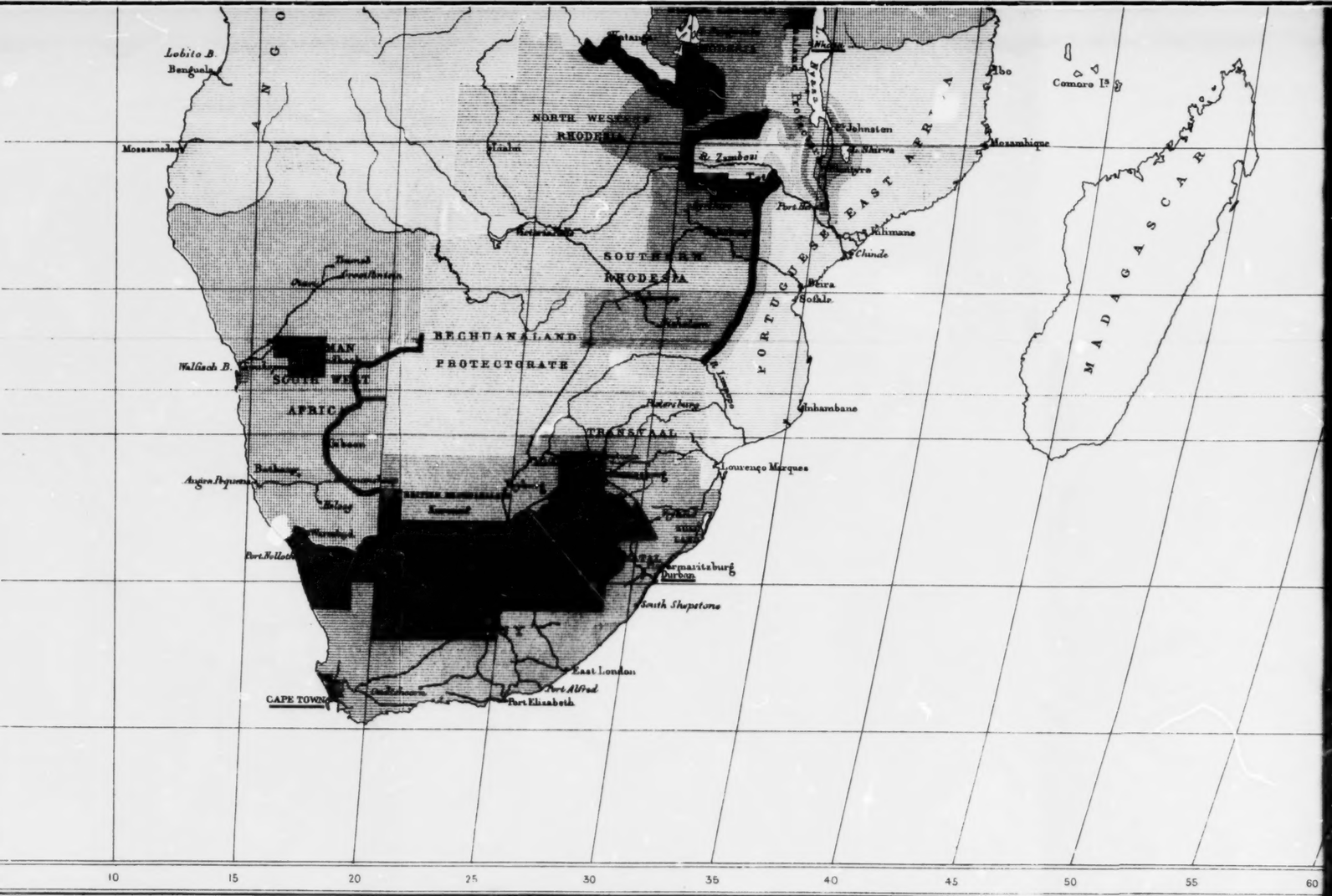
to illustrate the progress of surveys and explorations

REFERENCE

	British & Egyptian Territory	Foreign Territory
Surveys which may be taken as exact for reproduction on the scale of 250,000		
Surveys and explorations of an intermediate class		
Rough explorations		

NOTE — The whole of the coast-line has been charted by the Admiralty.

The longitudes of places underlined in black have been determined by telegraphic comparisons.



Geographical Section, General Staff N° 2436

Drawn and

Scale 1/20,000,000 or 1 Inch to 315·65 Miles

MILES 100 0 200 400 600 800 1000 1200 1400 MILES

Scale 1 Centimetre to 200 Kilometres

KILOMETRES 100 0 100 300 500 700 900 1100 1300 1500 1700 KILOMETRES

OF

AFRICA

to illustrate the progress of surveys and explorations

REFERENCE

	British & Egyptian Territory	Foreign Territory
ys which may be taken as exact for roduction on the scale of 250000		
ys and explorations of an termediate class		
explorations		

TE — The whole of the coast-line has been charted by the Admiralty.

The longitudes of places underlined in black have been determined by telegraphic comparisons.

Lobito B. Benguela NORTH WESTERN RHODESIA Mossamedes Zambesi R. Zambesi Port Herald Fort Johnston Mozambique Abo Comoro Is. PORTUGUESE EAST AFRICA Rikmane Chinde Beira Sofala MADAGASCAR Umtali Grand Bonaire SOUTHERN RHODESIA BECHUANALAND PROTECTORATE Walfisch B. SOUTH WEST AFRICA Pietersburg Inhambane TRANSVAAL Lourenco Marques Augra Pequena Kimberley Mafeking Port Nolloth Johannesburg Pretoria Durban South Shepstone East London Port Alfred CAPE TOWN Port Elizabeth

15 20 25 30 35

15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65

Drawn and printed at the War Office, Feb 1909
Corrected to Sept. 1913.

Scale 1/20,000,000 or 1 Inch to 315·65 Miles

MILES 100 0 200 400 600 800 1000 1200 1400 MILES

Scale 1 Centimetre to 200 Kilometres

KILOMETRES 100 0 100 300 500 700 900 1100 1300 1500 1700 KILOMETRES

6. A candidate who has passed the examination for the Associated Membership of the Institute of Civil Engineers or for the Professional Associateship or Fellowship of the Surveyors' Institution or the examination of the Institution of Municipal and County Engineers, or has obtained the diploma of the Cambridge University Department of Geography, will be exempt from the technical test referred to in paragraph 4 (*b*) above.

7. Candidates who have passed the qualifying tests or have been exempted will then be required to undergo a medical examination by one of the medical advisers to the Colonial Office in London, Liverpool, Edinburgh, or Dublin. A fee of one guinea will be charged for this examination.

8. According to the number of vacancies, candidates will then be sent to the Ordnance Survey Office, Southampton, for a course of instruction not exceeding two months. If reported on favourably by the Director-General of the Ordnance Survey, but not otherwise, a candidate will become a Survey Probationer and will be granted the amount of his actual railway fares* incurred in connexion with the course, and a lodging allowance of 2*s.* 6*d.* a day and a subsistence allowance of 5*s.* a day for each day spent at Southampton. No travelling expenses other than first class railway fares will be admitted, and return tickets must be taken when any saving would be effected thereby.

9. If the number of candidates reported on favourably by the Director-General of the Ordnance Survey is in excess of the number of vacancies then in existence, the selection of those Probationers first to be sent out will be at the discretion of the Secretary of State. The remainder will be placed on a waiting list pending the occurrence of vacancies. No salary or allowance can be issued during the period of waiting, but a Probationer on the waiting list will have priority over all candidates for Probationerships who attend a subsequent course of instruction unless for any reason he desires his allocation to a particular Colony or Protectorate to be deferred. In the latter event he will be allowed to remain on the list for a further period not exceeding twelve months.

10. A Survey Probationer on being sent out to the Colony or Protectorate to which he is posted will be provided with a free passage on his signing an agreement to refund its cost in the event of his leaving the service of the Government during the period of probation or, in the event of his services being retained, within three years of the date of his arrival, for any reason other than physical or mental infirmity. Passages booked by mail steamer to Ceylon or the Federated Malay States are second class, but in all other cases first class passages are provided. He will draw half pay on the voyage out, and will not begin to draw full pay until his arrival in the Colony or Protectorate.

The salaries and allowances paid to Probationers are as follows:—

Ceylon.— £250 per annum with house allowance of £50 per annum, and, when travelling on duty, the usual travelling and personal allowances specified from time to time by the General Orders of Ceylon, which may be consulted in the Colonial Office Library.

Federated Malay States.—£275 per annum with free quarters. Field allowance $3 and camp allowance $2 a night.

Uganda.—£250 per annum, with free quarters or an allowance at the rate of 10 per cent. of salary when at a recognised station. When travelling on duty (that is, for the greater part of the time in most cases), a travelling allowance of Rs. 4 a day will be issued from the 1st of April, 1914.

11. At the end of one year he will, if approved by the Surveyor-General or Director of Surveys, be appointed to the Department at the ordinary rate of pay attached to the appointments of Assistant Superintendent of Surveys, Second Grade Surveyor, or Junior Staff Surveyor, as the case may be. The appointment will in the first instance be for three years in the case of Ceylon, and for 30 months' service and the leave incidental thereto in the case of Uganda, with a prospect in each case of re-engagement if the Surveyor's service continues to be satisfactory. In the Federated Malay States a Surveyor may be

* Travelling expenses are not granted in respect of the candidate's call at the Colonial Office or his qualifying or medical examinations.

placed on the pensionable establishment at the end of his probation, provided that he has then obtained the language qualification. In Ceylon, also, a Surveyor has a prospect of ultimate appointment to the permanent establishment, while in Uganda nine, and in East Africa only two, of the appointments in the Survey Department are permanent and pensionable.

12. Information as to the emoluments of the posts mentioned in paragraph 11 and of senior appointments is included in Appendix III. to this pamphlet.

13. If at the end of a year's probation a Probationer is not approved, his appointment will be terminated, and he will have no claim to any compensation beyond a free passage back to England. The probationary period of one year may, however, be extended at the discretion of the Governor or High Commissioner if the extension is recommended by the Surveyor-General or Director of Surveys on account of special circumstances.

14. The Secretary of State does not by these arrangements preclude himself from considering an application for appointment from a Surveyor who is fully qualified in the practice of his profession but whose case cannot be dealt with under the ordinary procedure for filling Survey Probationerships.

Appendix I.

*Syllabus of Examinations.**

The qualifying examination in Mathematics referred to in paragraph 4 (*a*) will be conducted in accordance with the following syllabus :—

Algebra ... ... Up to quadratic equations and problems involving their solution.
The use of logarithms of numbers and problems (*e.g.*, in Interest and Annuities) involving them.
Construction of graphs for the comparison of thermometric scales. British and foreign measures, &c.
Graphical solution of problems dealing with corresponding values of two variables.

Geometry ... ... Theoretical and practical Geometry.

Mensuration ... Construction of scales (equal parts, diagonal, vernier, &c.).
Questions connected with the scale of maps.
Rectification of crooked boundaries.
Equal area problems.
Calculation of areas from various data (*e.g.*, areas of triangle from lengths of sides, of plot of land from rectangular co-ordinates, of sectors of circles, lunes, and curvilinear areas, &c.).

Plane Trigonometry Up to the solution of triangles, with applications to heights and distances. The use of trigonometrical and logarithmic tables.

†Practical questions under the following heads :—

(*a.*) Base measurements and determination of heights.
(*b.*) Solutions of triangles.
(*c.*) Traverses and co-ordinates.
(*d.*) Satellite stations and adjustment problems.
(*e.*) Inaccessibility problems.

Three papers will be set : (I.) in algebra, (II.) in geometry and mensuration, and (III.) in plane trigonometry. Three hours will be allowed for each paper.

The questions in each paper will be arranged with a view to testing the candidates' ability and accuracy in arithmetical work.

One hundred marks will be allotted to each paper.

Candidates will be required to obtain 55 marks in each paper. In the geometry and mensuration paper four questions (of which three only are to be attempted) will be set on geometry and nine (of which seven only are to be attempted) on mensuration. 40 marks must be obtained on the second section. In trigonometry ten questions (which will be marked equally) will be set, five of a general character and five under the heads marked † above. 35 marks must be obtained on the second section alone.

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* Intending candidates who have no previous knowledge of surveying and do not desire to arrange for special tuition will find useful information in the "Text-book of Topographical Surveying" (revised edition), by Colonel C. F. Close, C.M.G., R.E., published by the War Office.

A set of specimen questions is included in Appendix II.

The qualifying examination in the use of instruments will cover the transit theodolite (vernier or micrometer microscope), level (Cooke's or dumpy), chains, tape, plane table, Indian clinometer, trough compass, prismatic compass, and aneroid barometer. Candidates will be expected to have a general knowledge of the use of these instruments and to be able to set them up and adjust them.

It is to be understood that, while the examination is not competitive in the sense that the candidate who stands highest on the list will have any claim to priority of consideration, the marks obtained will be taken into account by the Secretary of State in comparing the merits of the various qualified candidates.

Appendices II. and III., not reprinted, will be found in the memorandum (Miscellaneous No. 225), relating to these appointments. It can be obtained on application to the Private Secretary to the Secretary of State, Colonial Office, S.W.

III.

REPORTS ON THE SURVEYS OF BRITISH AFRICA.

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ANGLO-EGYPTIAN SUDAN.

Governor-General ...	Lieut.-General Sir F. R. WINGATE, G.C.V.O., K.C.B., K.C.M.G., D.S.O.
Director of Surveys ...	Major H. D. PEARSON, R.E.
Assistant Director, Topographical Branch.	Lieut. A. G. McNeill, R.E.
Assistant Director, Cadastral Branch.	Mr. A. W. Fraser.
Inspector, Northern Provinces.	Mr. A. C. Pilkington.
Inspector, Southern Provinces.	Mr. C. B. Bevan.
Special Surveys... ...	Mr. L. Bolton. M. J. H. Goldsmith.
Chief Town Surveyor ...	Mr. A. A. R. Boyce.
Assistant Town Surveyor	Mr. M. V. Morris.

NOTE.—The Colonial Survey Committee is not directly concerned with the surveys of the Anglo-Egyptian Sudan, but an account of them is included in order to complete the review of the surveys of British Possessions in Africa.

Organization of the Survey Department.

Field.

Topographical Section ...	1 Assistant Director. 4 native surveyors.
Town Surveys	2 European surveyors. 6 native surveyors.
Maintenance	2 Inspectors. 32 native surveyors.
New Surveys	2 Inspectors. 16 native surveyors.

Office.

Headquarters	1 Director.
Cadastral Branch ...	1 Assistant Director. 16 native computers and tracers.
Reproduction	2 native draughtsmen. 2 native printers (zinc).

Present State of Topography.

Diagram II. shows the sheets which have been published on the scale of 1/250,000.

Most of the detail depends on rapid reconnaissance work only, but in the majority of the sheets some positions have been fixed approximately, either by topographical triangulation, by "latitudes and azimuths," or by observed latitudes, and longitudes by transport of chronometers.

No area, so far, has been completely surveyed. Provisional sheets on the scale of 1/100,000 have also been issued. Of these, 3 have been lithographed in England, 5 in Cairo, and 4 (1 from zinc and 3 sun-prints) have been reproduced in Khartoum.

The Work of the Past Year.

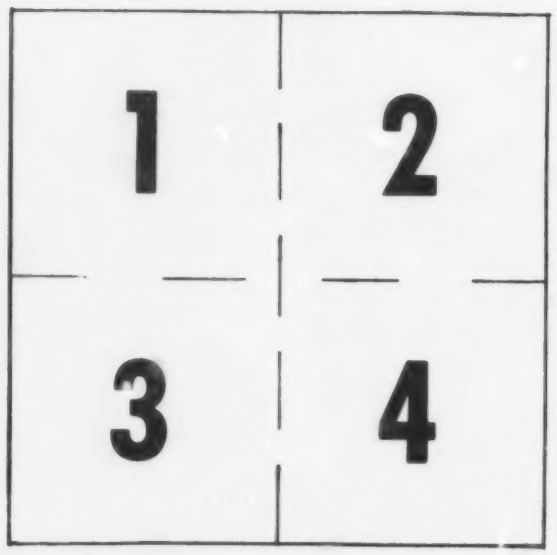
Topographical Survey.—The post of Assistant Director of Surveys was not filled till March, 1913, and no officer has been employed exclusively on topographical work.

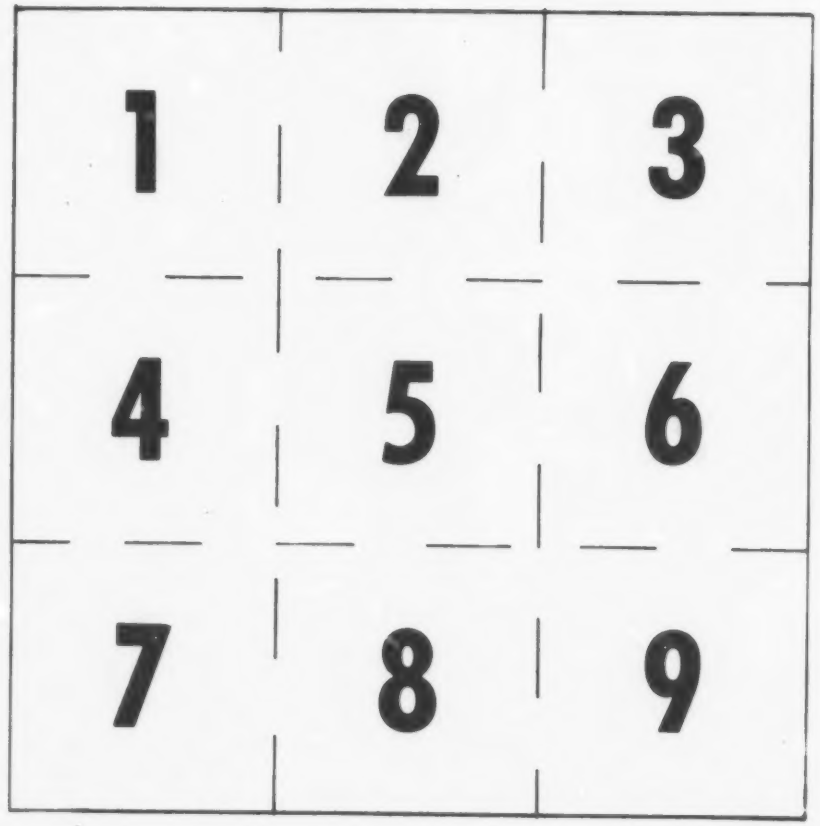
A further attempt to penetrate the Beir country was made by steamer during the summer, and the Pibor river was mapped as far south as the junction of the Kengen, about latitude 6° 45′ N. A survey of the Gila river (Gelo on old maps) was also made as far as the rapids, and a connection was made with Major Austin's work.

Three other tributaries of the Sobat and Pibor rivers were also mapped for some 50 miles of their course.

Mapping was carried out in the Moru country to the west of Mongalla, the work being connected with Capt. Coningham's Lado triangulation (1910–1911), and a geological expedition towards Lake Albert has furnished some information further south.

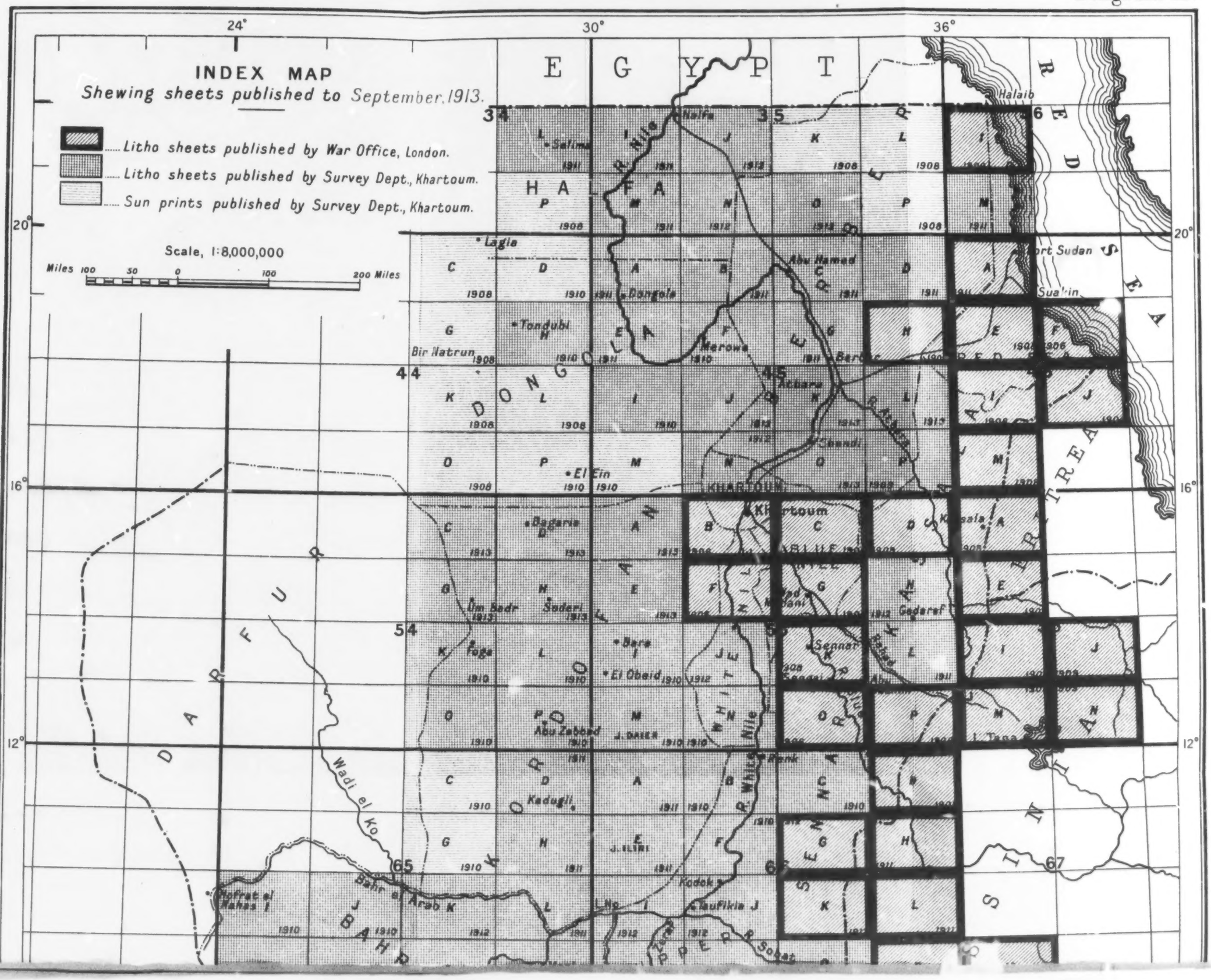
Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.

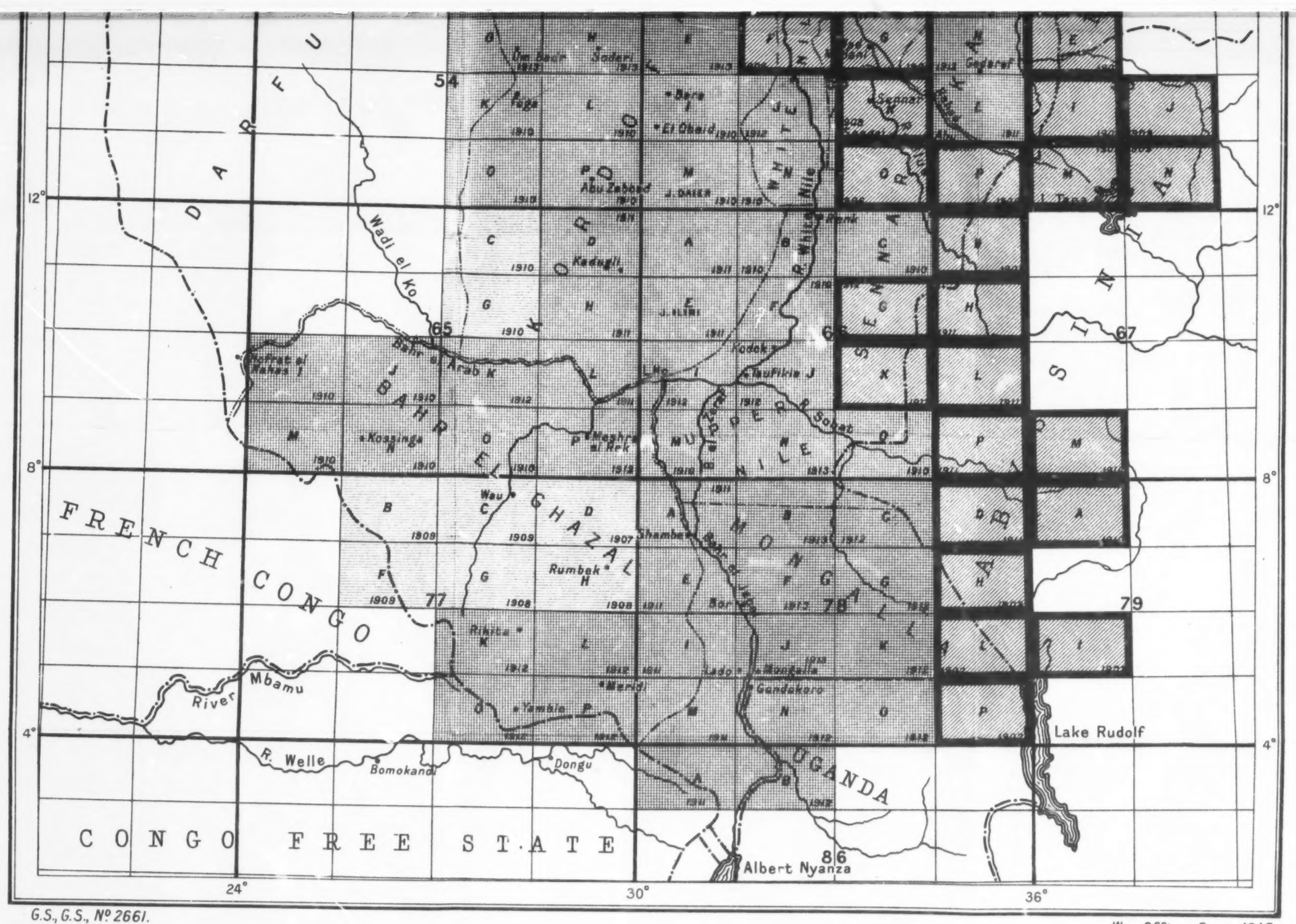




THE ANGLO-EGYPTIAN SUDAN.

Diagram II.





G.S., G.S., Nº 2661.

War Office, Sept. 1913.

A reconnaissance which has just been made east of the Nile between Nimule and Lake Rudolf should add to the knowledge of that part of the Sudan.

A party from the Irrigation Department has lately marched from Shambe, on the left bank of the Bahr-el-Jebel, to Lake No, and their work should define the limits of the swamps on that bank of the river.

In other parts, a few sketches of new roads, etc., have been received from province officials, and have been embodied on the existing sheets, for reproduction when revised editions are issued.

New editions of 30 sheets of the 1/250,000 series have been brought out during the year

Lieut. A. G. McNeill, R.E., has joined the Department and has started for Talodi with a section of native plane-tablers, to survey the Nuba Mountains Province.

The province is very thickly covered with hills, many of them inhabited, and it is intended to map on the scale of 1/125,000. It is hoped that, if undisturbed, Lieut. McNeill will be able to finish, in the course of the next few years, the first complete survey of an area in the Sudan.

Cadastral Survey.—Detail cadastral survey has been continued in the Gezira between the Blue and White Niles, 4,906 iron beacons, at intervals of a minute of arc, having been fixed as the framework for this survey. During the past twelve months the plane-table parties have been at work on the White Nile side in the Geteina District of the White Nile Province. Properties are here very much larger than on the Blue Nile, and upwards of 800,000 feddans (a feddan is approximately equal to an acre) have been surveyed in detail during the year.

The computation of areas is some two years behind the work of the field parties. It is not possible, therefore, to form an estimate of the final cost of the work. The expenditure, up to the present, has been £E.53,781.

The beacon framework has extended over 3,850,000 feddans; 2,400,000 feddans have been surveyed in the field, comprising very roughly 40,000 holdings. The area work of approximately 25,000 holdings has been completed. From these figures it seems probable that the eventual cost will work out to about 2½ P.T. per feddan, or roughly 6*d.* an acre.

In Sennar, where cadastral survey is next to be taken up, the conditions are somewhat different, the village clearings being separated from one another by large patches of thick bush and low forest. An attempt is being made to fix two beacons per village (as starting points for detail survey) by resection from Jebels Moya, Segadi and other hills which have been triangulated between the 13th and 14th parallels of north latitude.

Town Survey.—The survey of Khartoum North has been completed, and that of Khartoum itself is in hand. As the country continues to develop, the demand for town surveys has greatly increased. An extra assistant has lately been sanctioned, in order to permit the Chief Town Surveyor to visit and prepare schemes for the survey of outlying towns.

A staff of four surveyors is still kept busy aligning and allotting compensation plots in Omdurman, and rebuilding is going on at a very rapid rate. The petitions for alignment continue at the rate of 10 to 20 per diem, and it seems probable that the pressure will continue for another two or three years.

Application has been made for surveys of Kassala, El Obeid, Kamlin, Wad Medani and Rufaa, and it is hoped that something may be done to meet the demand.

EAST AFRICA PROTECTORATE.

Governor	Mr. H. CONWAY BELFIELD, C.M.G.
Director of Surveys	Captain G. C. WILLIAMS, R.E.
Deputy Director of Surveys, Trigonometrical and Topographical Branch.	Captain A. M. COODE, R.E.
Deputy Director of Surveys, Cadastral Branch.	Mr. A. E. TOWNSEND.
Assistant Directors of Surveys, Trigonometrical and Topographical Branch.	Captain H. N. KEMPTHORNE. Lieut. G. A. P. MAXWELL, R.E.
Assistant Director of Surveys, Cadastral Branch.	Mr. T. H. GALBRAITH.

ORGANIZATION OF THE SURVEY DEPARTMENT.

Field.

Trigonometrical and Topographical Branch	Deputy Director. 2 Assistant Directors. 6 European surveyors (N.C.O.'s, R.E.).
Cadastral Branch	1 Assistant Director. 25 European surveyors. 3 Indian surveyors. 2 native surveyors.

Office.

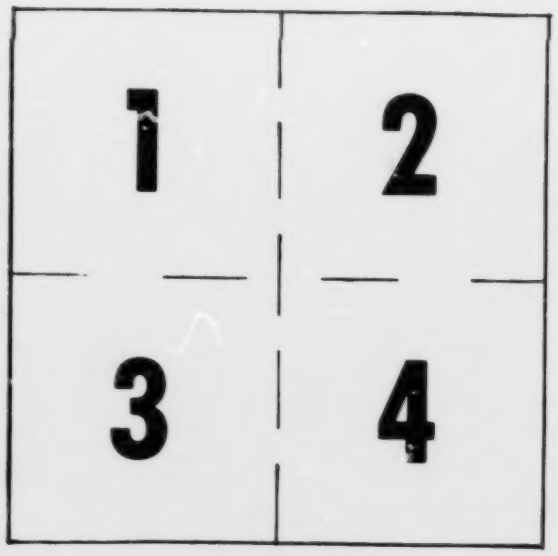
Superintending Staff	1 Director. 2 European clerks.
Cadastral Branch	Deputy Director (sometimes in field). 4 European clerks. 1 Goanese clerk. 4 European computers. 7 European draughtsmen. 1 Indian photographer. 5 Indian tracers.

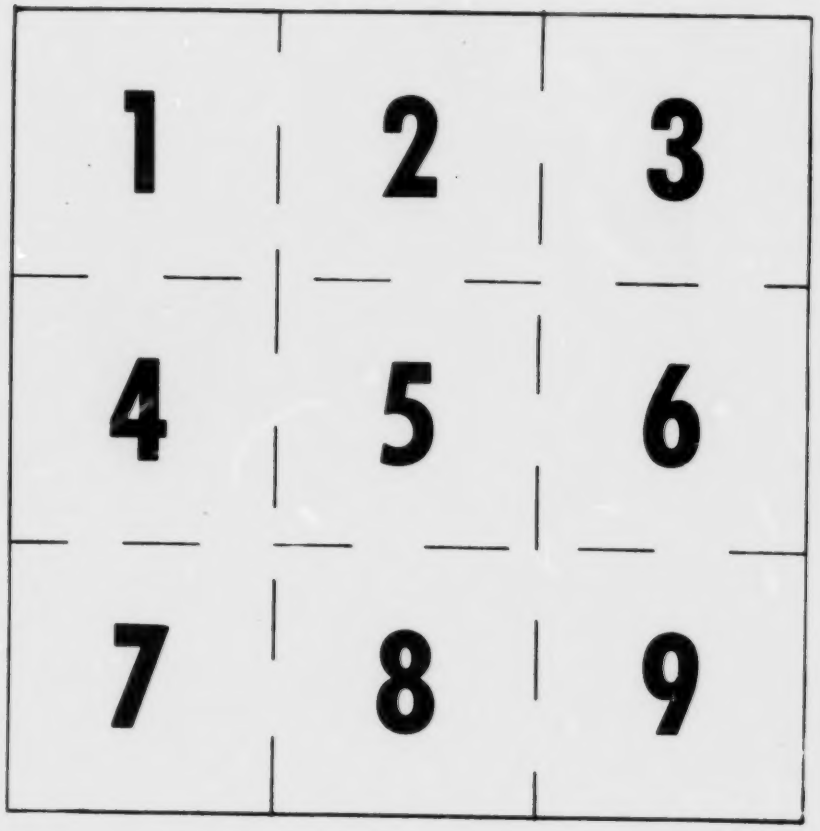
There are also 17 licensed surveyors in the country who, although not on the staff of the Department, undertake some of the farm surveys.

PRESENT STATE OF TOPOGRAPHY.

This is shown on Diagram III.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.

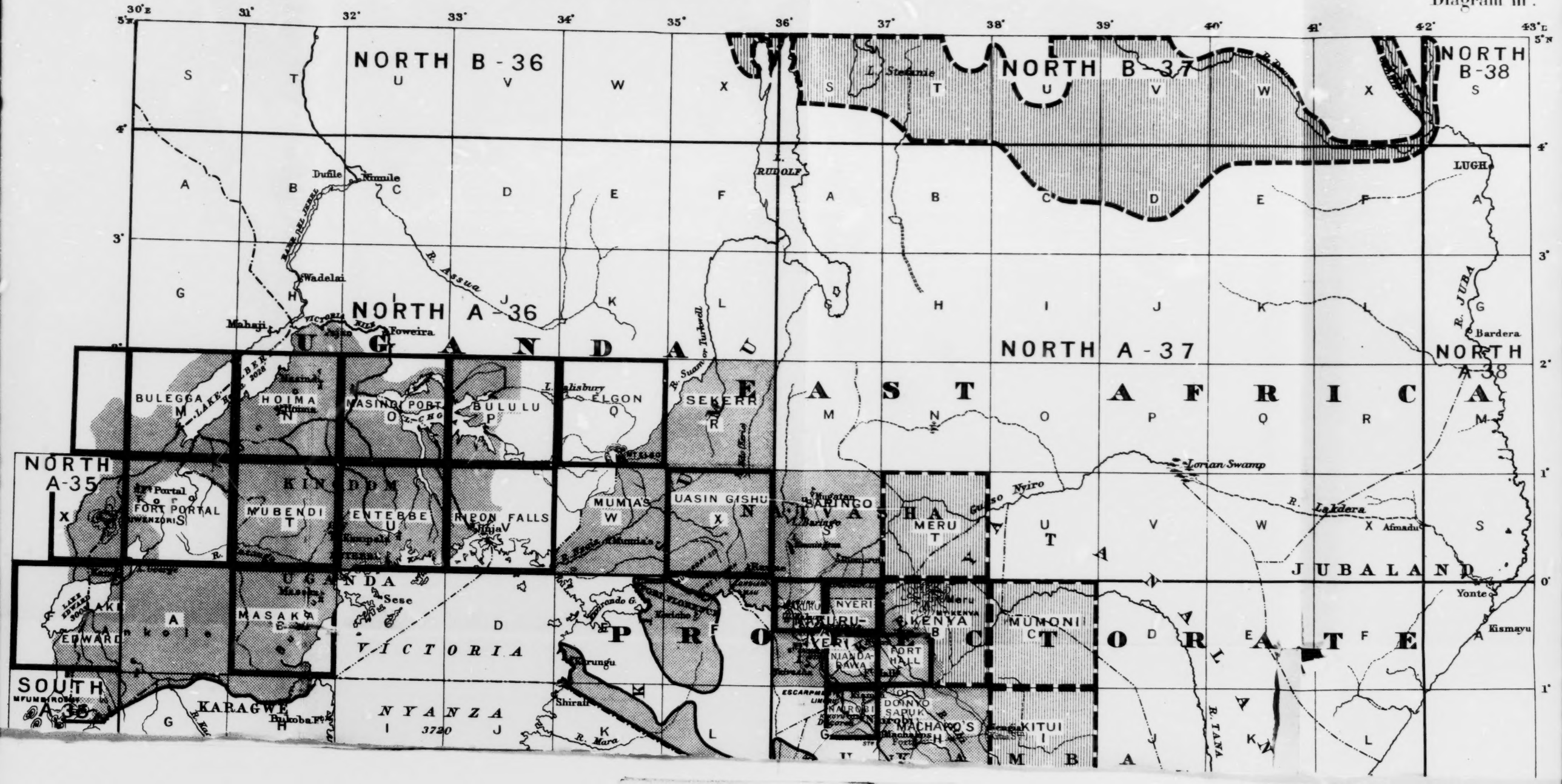




INDEX MAP

EAST AFRICA PROTECTORATE AND UGANDA

Diagram III.



NORTH A-35

SOUTH A-36

SOUTH A-37

SOUTH A-38

SOUTH B-36

SOUTH B-37

GERMAN EAST AFRICA

UGANDA PROTECTORATE

KENYA COLONY

ITALIAN JUBALAND

Fort Portal

FORT PORTAL

KINGDOM OF TORO

MUBENDI

ENTEBBE

RIPON FALLS

MUMIAS

UASIN GISHU

BARINGO

MERU

Lorian Swamp

Lake Rudolf

Lake Edward

Lake Albert

MASAKA

Sese Is.

VICTORIA NYANZA

I 3720

Shirati

R. Mara

KARAGWE

Bukoba

R. Kagera

L. Kivu

NYERI

KIRU-YERI

NJANDA-RAWA

FORT HALL

ESCARPMENT

KAROSI

OLDONYO SAPUK

MACHAKOS

KITUI

MUMONI

R. Tana

Yonte

Kismayu

Olgos

Muansa

L. Natron

MAKINDU

YATTA PLATEAU

Witu

Lamu

MANGEA

MACKINNON ROAD

MALINDI

V AND W

TAKAUNGU

MOMBASA

MT KILIMA

MT MERU

Moshi

Arusha

L. Jipe

VOI

Mwatate

Ujiji

Tabora

Wilhemstal

Vanga

Tanga

Pemba I.

Pangani

REFERENCE

Telegraph lines

Railways

Cart roads

Cleared (Trade) routes

Caravan tracks

Gov.t Stations

Geographical Section, General Staff; No 2291.(a)

Topography completed in the field

Topography published

Sheets published

Provisional sheets compiled 1:250,000

" " published "

Scale 1/4,000,000 or 1·014 Inches to 64 Miles

100 50 0 100 200 300 Miles

Revised Aug. 1913.

The Work of the Past Year.

Trigonometrical and Topographical Branch.—Captain Coode was appointed British Commissioner on the Mahagi Boundary Delimitation in Uganda, and his services were lost to the Department from December 1st, 1912.

The health of the staff has been good.

Triangulation.—An area of 11,096 square miles was covered by triangulation; this included 1,564 square miles of tertiary triangulation. A further area of about 650 square miles was covered by intersected points. It will be seen from Table I below that the average triangular errors, while still within the specified limits, are larger than those of previous years. This is due to bad weather experienced during much of the observing. Wooden quadripods, with permanent marks buried under cairns of stones, were again used as trigonometrical beacons.

Major and minor triangulation was done on the following sheets :—

North A-37 / S, Baringo ... ... finished : about ⅔ done before.

South A-37 / H, Machako's ... finished : about ¼ done before.

South A-37 / B, Kenya ... ... finished : about ¼ done before.

South A-7 / O, Kibwezi ... ... ⅓ finished.

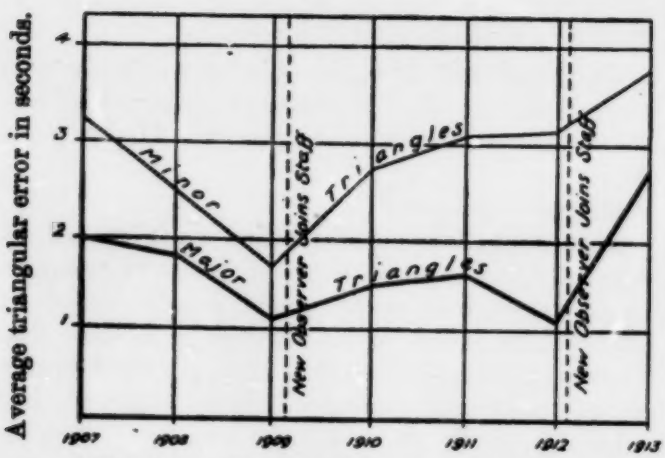
North A-36 / W, Mumia's ... ... finished.

The cost of triangulation was 6·6 shillings per square mile, the reduction of 12·8 shillings per square mile compared with the cost in 1911–12 being due to the change from the Coast to the Highlands. As in previous years, the officers working on the triangulation were followed closely by the topographers, co-ordinates of all points being computed and supplied to the plane-tablers in the field.

Table I.

Comparative Annual Statement of Triangulation.

Year ending 31st March.	Major Triangles.			Minor Triangles.		
	No.	Average Triangular Error.	Area.	No.	Average Triangular Error.	Area.
		"	Sq. miles.		"	Sq. miles.
1907	29	1·97	1,375	67	3·20	835
1908	50	1·77	7,320	163	2·51	3,610
1909	27	1·11	5,624	8	1·66	600
1910	34	1·45	738	20	2·68	1,117
1911	38	1·59	4,821	75	3·02	4,239
1912	18	1·06	2,629	23	3·10	3,615
1913	55	2·72	8,209	26	3·72	1,323



The above diagram shows part of Table I. in graphic form.

Topography.—The topography of those parts of the Protectorate which are occupied by white settlers is nearly finished, and the mapping of the big native reserves is already in hand.

Topography on the scale of $\frac{1}{125000}$ in areas which are to be taken up by farmers has proved most useful, not only in drawing up preliminary allotment schemes, but also to the cadastral surveyors who are afterwards engaged on the farm and road surveys.

It is recommended that this scale should be adopted in future for all areas occupied by white settlers.

The sheets on the $\frac{1}{250000}$ scale have been found to be very useful as general maps of the country.

A new administrative map on the scale of $\frac{1}{1000000}$ is wanted urgently. It is being compiled and will be printed shortly.

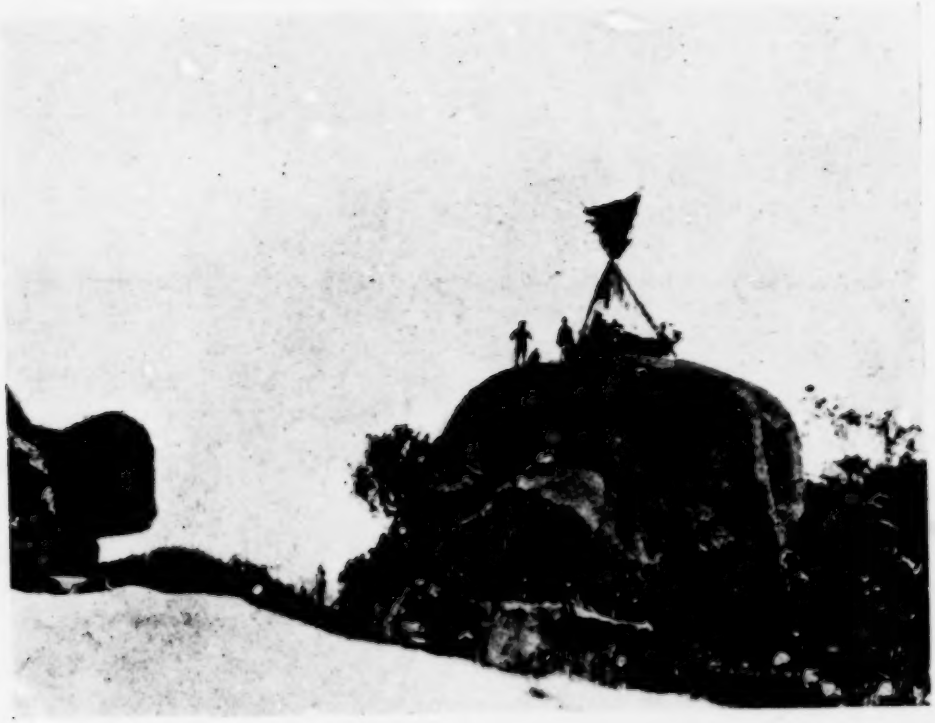
The following topography was done last season :—

Scale.	Sheet.		Area. Sq. miles.
$\frac{1}{125000}$	South A-37 / H-1	(Ol Doinyo Sapuk)	1,188
$\frac{1}{250000}$	South A-37 / H	(Machako's)	9,500
	North A-36 / X	(Uasin Gishu)	
	North A-37 / S	(Baringo)	
	North A-36 / W	(Mumia's)	
$\frac{1}{250000}$ (reconnaissance)	South A-37 / O	(Kibwezi)	1,000
		Total ...	11,688 sq. miles.

The cost of topography was 8·0 shillings per square mile, a reduction of 3 shillings per square mile compared with the cost in 1911–12.

PLATE I.

TRIGONOMETRICAL STATION IN EAST AFRICA.



OKWARA BEACON, KAVIRONDO COUNTRY.

Drawing and Compilation.—The following sheets have been sent to England during the year for printing:—

$\frac{1}{250000}$ series ... ... North A-36 / X (Uasin Gishu); North A-37 / S (Baringo); South A-37 / H (Machako's)

$\frac{1}{250000}$ provisional series North A-36 / R (Sekerr); North A-36 / Q (Elgon)

The East Africa Protectorate part of the Elgon sheet is final.

The above sheets have been reproduced by the Plex process, in the survey office in Nairobi, for use while the sheets are being printed in England.

The following sheets have also been reproduced locally by the Plex process, but the demand for them is not at present sufficient to justify the expense of reproduction in England:—

$\frac{1}{125000}$ series ... ... South A-37 / H-I (Ol Doinyo Sapuk)

$\frac{1}{250000}$ provisional series South B-37 / C (Mwa Kijembe); South A-37 / M (El Emombarasha)

The $\frac{1}{1000000}$ sheets, North A-37 and North A-38, are being compiled locally, and the Geographical Section of the General Staff are compiling South A-37. These should all be printed in 1914.

Table II.

Comparative Annual Statement of Topography.

Year ending 31st March.	Scale. $\frac{1}{63360}$	Scale. $\frac{1}{125000}$	Scale. $\frac{1}{250000}$
	sq. miles.	sq. miles.	sq. miles.
1907	—	—	2,393 (reconnaissance)
1908	447	—	—
1909	973	—	—
1910	450	3,342	—
1911	688	2,987	8,575 (4,900 reconnaissance)
1912	—	2,060	5,390 (500 reconnaissance)
1913	—	1,188	10,500 (1,000 reconnaissance)

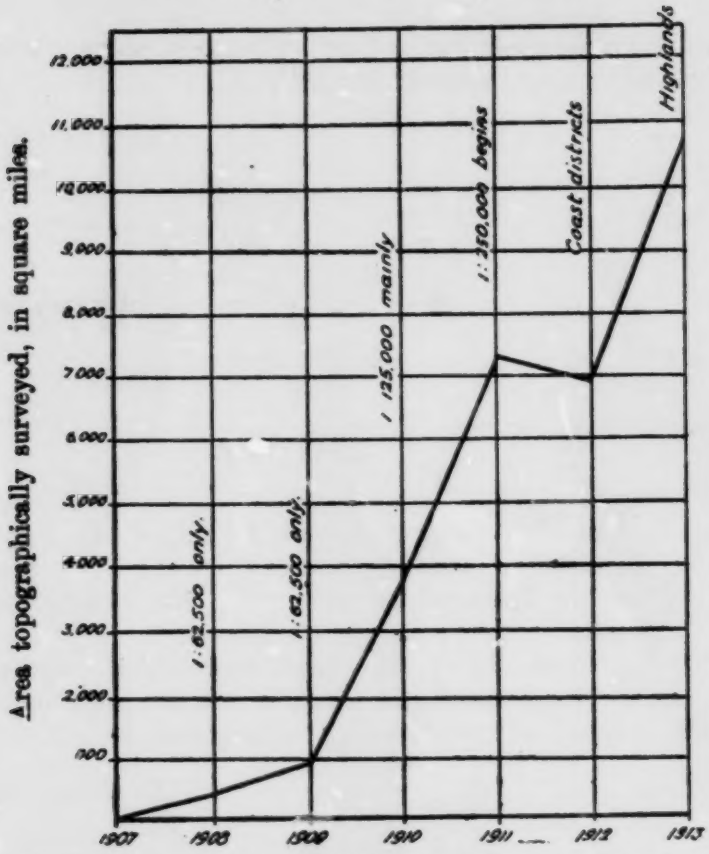


Diagram to illustrate Table II, omitting reconnaissance.

Cadastral Branch.—The health of the staff has been bad. Many of the surveyors have suffered from malaria, especially on the coast, where the hot season has been very trying. Mr. D. G. Crofts, a senior staff surveyor, died in July, 1912, from blackwater fever in the Trans-Nzoya District. He was an excellent surveyor, and his loss was a severe blow to the department. One Indian surveyor died while on leave.

The following resigned during the year:—Three surveyors (two to take up private work as licensed surveyors), two draughtsmen and two Indian tracers. Vacancies were filled by promotions and new appointments, and by the end of the year the staff was complete, except for one surveyor. Time was lost while the changes were being made.

The acreage surveyed is larger than that in the three preceding years. Yet the arrears have increased from 1,606,797 acres to 1,790,608 acres.

A more thorough check both of Government and licensed surveyors' work was made, as the Director of Surveys, the Deputy Director and Assistant Director of the Cadastral Branch all spent part of the year in checking surveyors' work in the field. This check was found to be essential, and, as it is combined with a rigorous office check by the computers, there is very little chance of bad work being passed.

More attention is now paid to road schemes in connection with farm surveys, the proposed road access to every farm being shown.

Surveyors.—There has been a marked improvement in the work, due to better supervision.

The most extensive farm surveys were the Uasin Gishu final surveys, and the allotments in the coast lands, and in the districts of Trans-Nzoya, Ol Doinyo Sapuk, Kaimosi, Kiu, Nyeri, Elmenteita and Kibos-Muhoroni.

Township surveys still take up much of the Government surveyors' time. They have been expensive in the Nyanza Province, owing to the long distances between townships.

A contoured survey of part of Mombasa Island is being made, as the basis for a new drainage scheme for the native town.

Three extra surveyors were allowed, in June, for the coast land settlement surveys. Since then progress has been better.

Sickness prevented the survey staff at times from keeping pace with the arbitration boards. Demarcators were therefore attached to the boards for preliminary survey. Final survey followed as soon as possible. This was more economical than the previous system, as large blocks could be finally surveyed at one time.

Seven qualified surveyors took out licences during the year, bringing the number up to 21, of whom 17 are at present in the country.

Computers.—This branch, which is responsible for checking the field notes, computations and plans of the Government and licensed surveyors, and for supplying co-ordinates and other technical details for surveys to be executed, was formed in 1910.

Since then, the number of Government and licensed surveyors has increased, and, as most of the latter employ assistants, the computing branch has been unable to keep abreast of its work. An increase of three computers has been sanctioned for 1913-14; this will adjust the proportion of computers to surveyors.

A specimen survey, with printed computation forms and field-books, is now issued to all surveyors.

Drawing Office.—The work is up to the standard of past years and has been done more quickly. Several draughtsmen were transferred during the year to the survey and computing branches.

A useful skeleton map of the Protectorate, on the scale of 1/1,500,000, was prepared and printed.

The Public Map Office, opened in 1911, has proved of great value. The draughtsman in charge shows and sells maps to the public, registers all plans sent to the survey department, records all farms and areas surveyed, issues deed plans for conveyance, and prepares special maps that may be required from time to time.

Table III.

Detail of Cadastral Surveys in Year ending 31st March, 1913.

Nature.	Number.	Acres.
Grazing	303	869,773
Agricultural	64	85,127
Crown Lands...	3	45,044
Reserves	47	24,058
Private Sub-division...	43	21,435
Re-surveys	31	17,030
Coast Land Surveys...	123	9,335
Forest Surveys	2	4,432
Township Contour Surveys... ...	6	2,943
Fibre, Cotton and Rubber	5	1,086
Road Surveys	8	1,066
Building Plots	338	710
Check Surveys	3	30
Totals	976	1,082,069

The above figures do not include the miscellaneous surveys shown below :—

Nature.	Area.
Tertiary Triangulation	1,340,280 acres.
Preliminary survey for laying out farms, Kiu	128,000 „
Incidental traverses	87,194 feet.

Table IV.

Comparative annual statement of Cadastral Surveys.

Year ending 31st March.	Surveys finished.		Surveys ordered but not finished.
	Number.	Acres.	
			Acres.
1908	1,182	862,760	350,000
1909	294	1,161,583	350,000
1910	268	553,261	813,000
1911	482	484,266	1,519,930
1912	1,034	690,995	1,606,797
1913	976	1,082,069	1,790,608
Totals	4,236	4,834,934	—

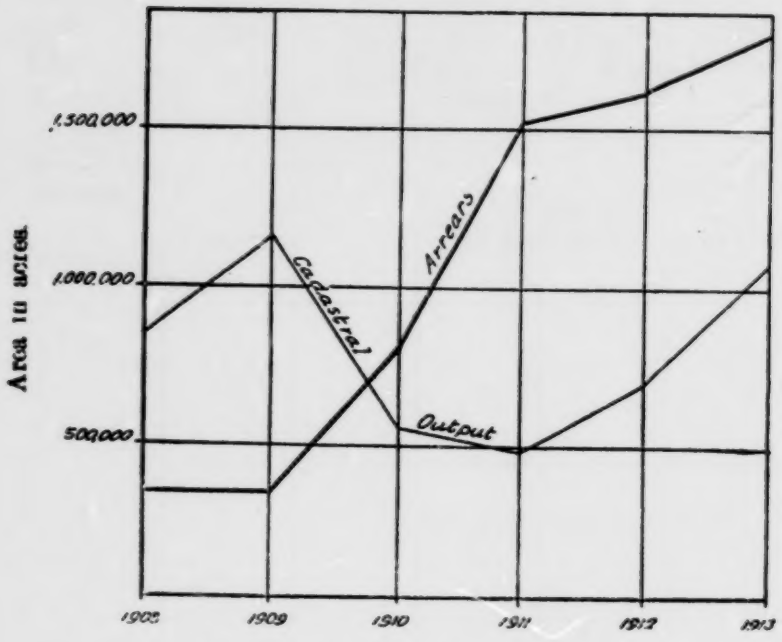


Diagram to illustrate Table IV.

Cost.

Expenditure and Revenue.—Table V gives a comparative annual statement.

TABLE V.

Year ending 31st March.	Trigonometrical and Topographical Branch.		Cadastral Branch.		Revenue.
	Estimated.	Spent.	Estimated.	Spent.	
	£	£	£	£	£
1908	8,506	6,087	12,347	13,885	3,909
1909	8,416	6,427	13,049	13,177	860
1910	8,029	8,571	13,064	13,181	1,495
1911	8,797	7,246	12,739	13,460	4,727
1912	8,546	6,796	16,260	14,965	5,280
1913	8,735	8,075	22,065	21,067	1,108

The proportional cost was :—

	Per cent.
Personal emoluments	52
Other charges	48
	100

The details of revenue for the past year are :—

	£
Survey fees	966
Sale of maps, &c.	133
Sale of War Office maps	9
	1,108

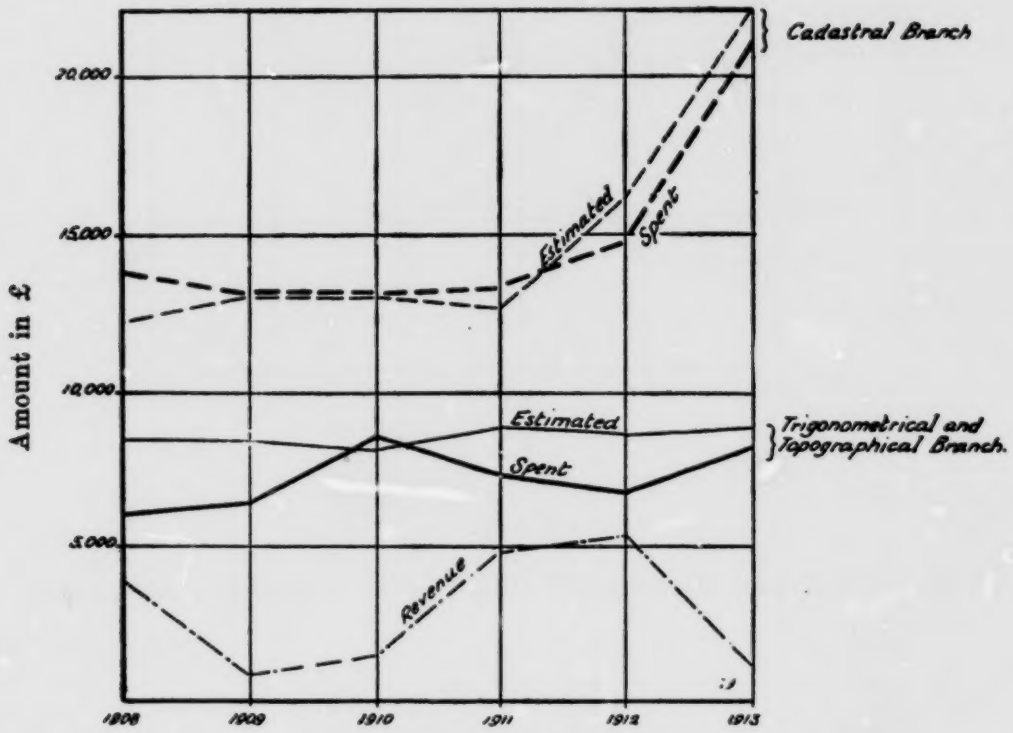


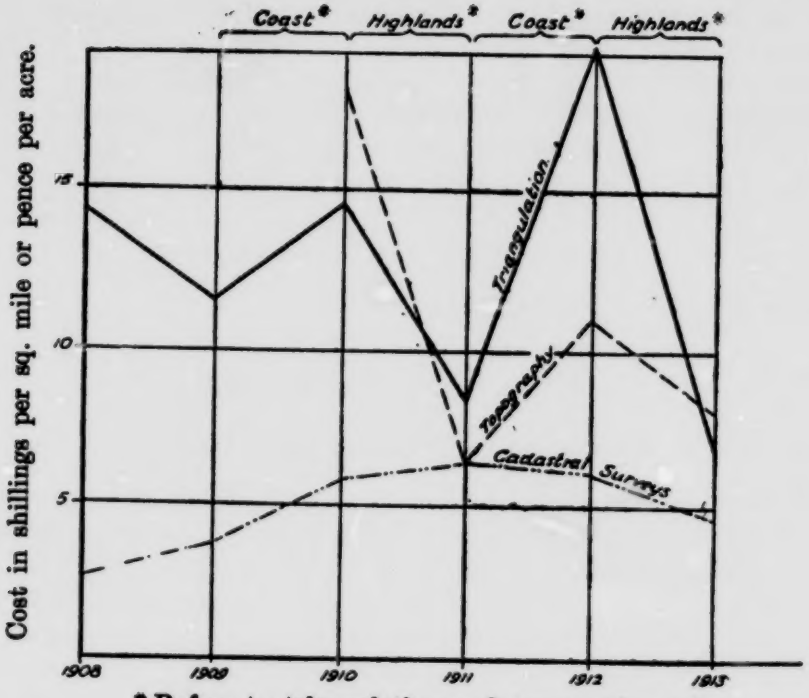
Diagram to illustrate Table V.

The divergence of the revenue and cadastral expenditure lines is due to the very small number of allotments of land to the public during the past year, and the large number of farm surveys for which fees will not be received till the farms are allotted.

Cost of Different Classes of Survey.—Table VI gives a comparative annual statement.

TABLE VI.

Year ending 31st March.	Triangulation. Shillings per square mile.	Topography. Shillings per square mile.	Cadastral surveys. Pence per acre.
1908	14·4	—	2·71
1909	11·6	—	3·73
1910	14·6	18·2	5·81
1911	8·6	6·5	6·31
1912	19·4	11·0	5·96
1913	6·6	8·0	4·51



* Refers to triangulation and topography only.
Diagram to illustrate Table VI.

Miscellaneous.

A small observatory was built in Nairobi at the end of the year. A transit instrument and a chronometer have been set up in it, and are being adjusted. These will be used for the transmission of Nairobi time throughout the Protectorate.

General Comment.

The work of this survey is very satisfactory, but it would appear from the above report that the strength of the department is not equal to the task of coping with the enormous demand for cadastral surveys.

GOLD COAST.

Governor	Sir H. C. Clifford, K.C.M.G.
Director of Surveys	Captain E. F. W. Lees, R.E.
Assistant Directors of Surveys	Captain H A. L. Hall, R E.
	Captain P. J. Mackesy, R.E.

Organization of the Survey Department.

Headquarters	Director of Surveys. Clerk.
Trigonometrical and Topographical Branch.	2 Assistant Directors. 6 European surveyors (N.C.O.'s, R.E.).
Cadastral Branch	Chief Surveyor. 5 European surveyors. 3 native surveyors.
Drawing Office	1 European draughtsman.

An addition to the staff of one European draughtsman, two junior native surveyors and two junior native draughtsmen has been approved.

Three surveyors and one draughtsman were employed on the Accra and Seccondee Waterworks and Drainage Schemes until October 29th, 1912, when they sailed for England. Their work is finished.

Present state of Topography.

This is shown on **Diagram IV.**

The Work of the Past Year.

Trigonometrical and Topographical Branch.

The health of the staff has been bad. Both officers were on the sick list for a month during the field season (September to May), and Sapper Sheridan, a capable and hard-working surveyor, died at Salaga on December 5th. During the first two months of work in the field there were 37 days of sickness. There was a further cause of delay. One of the surveyors did not leave England, and the man who was sent out to replace him was a failure and had to be sent home again.

There was, therefore, a shortage of one-third of the surveyors during the field season. This, combined with the bad health of the staff, necessitated a re-adjustment of the original scheme (given in last year's report), which had been drawn up for a staff of two officers and six surveyors.

Triangulation.

The survey of the Northern Territories has not yet reached the area within which triangulation is considered practicable.

Topography.

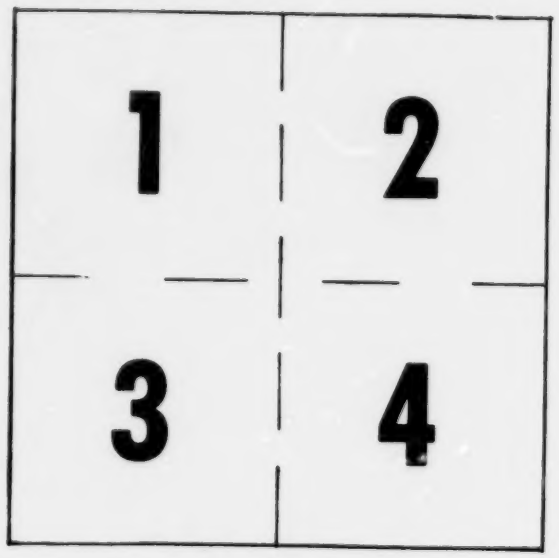
Work has been done both in the Northern Territories and in Northern Ashanti.

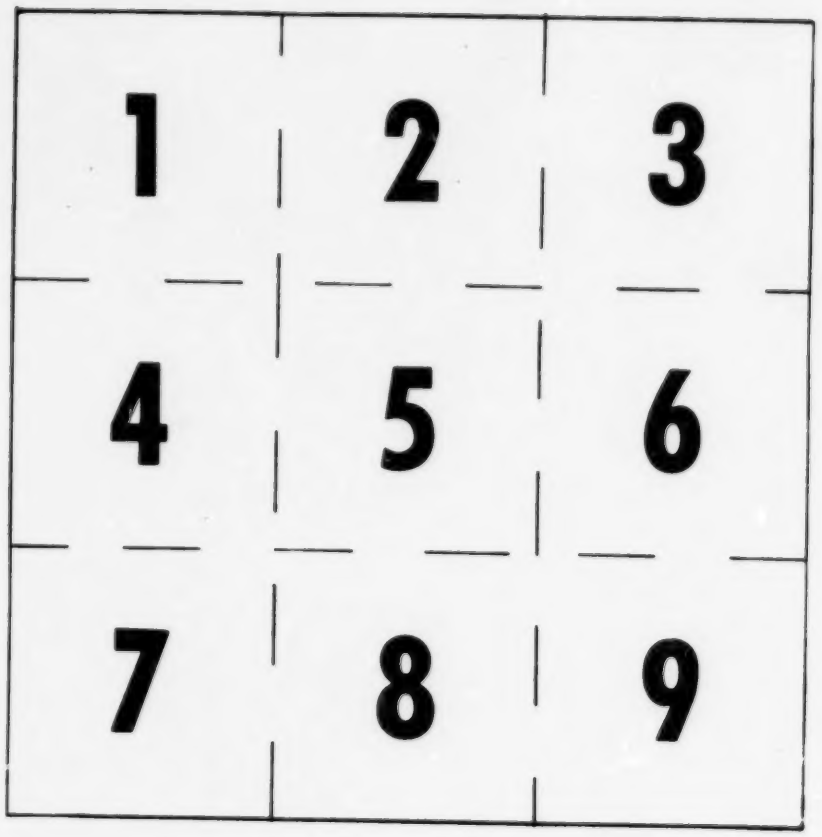
Northern Territories.—As recorded in last year's report, an officer and two surveyors were employed, during the field season of 1911–12, in forming a basis for the topography to be done in 1912–13.

The first objective in this last season was the telegraphic determination of the longitude of Nkoranza from Coomassie. The attempt failed owing to a faulty circuit and bad weather, the chief hindrance being induction.

Work was done on rigid, subtense and secondary traverses until December 31st, 1912, when field sheets were prepared. By the end of January the four surveyors were at work on the field sheets, and after a month's supervision (two of the surveyors being inexperienced) the officers left to investigate discrepancies in detail on the German boundary, to continue traverses and to begin beacon-building in the area suitable for triangulation.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





INDEX MAP

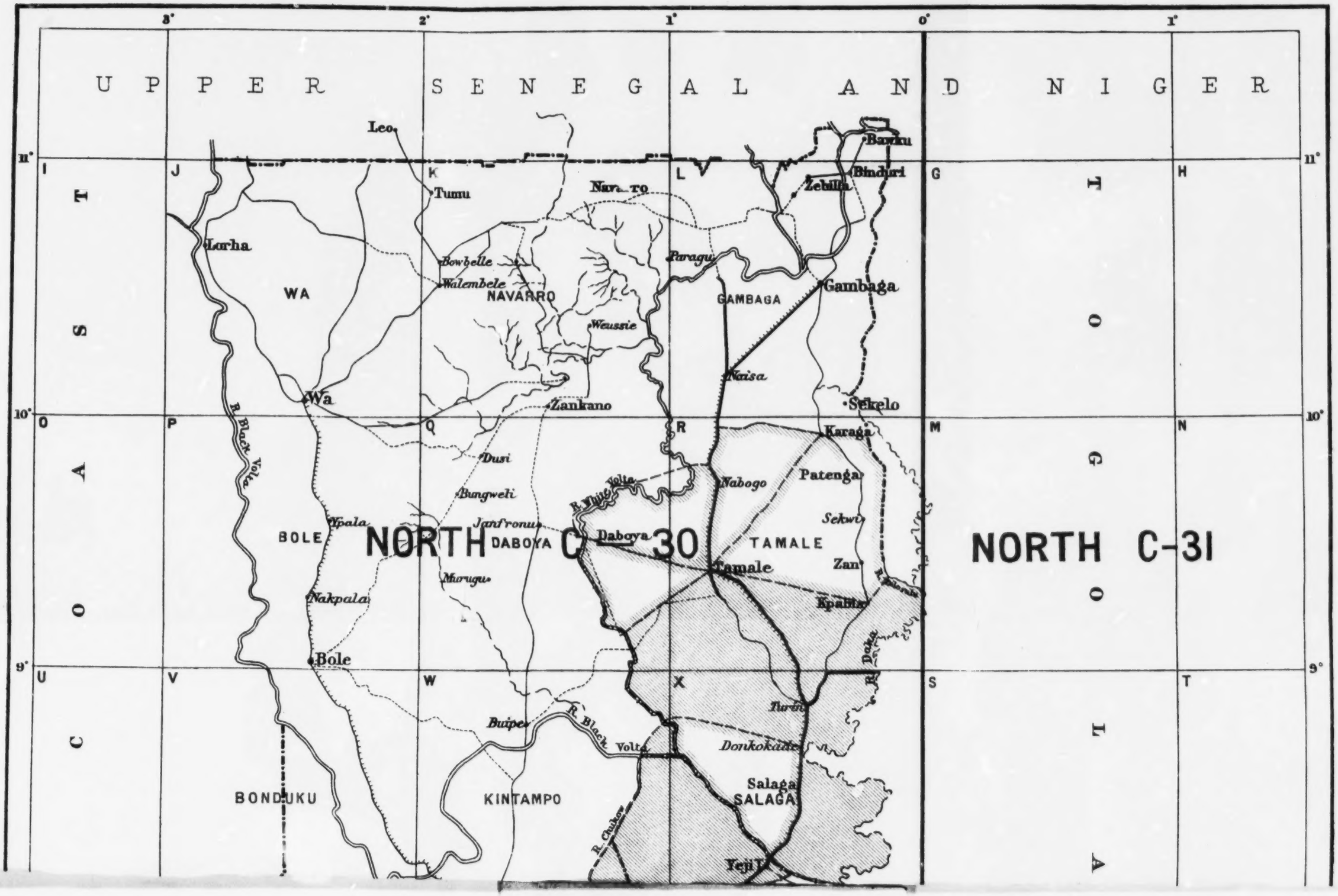
TO SHEETS OF THE 1 : 125.000 & 1 : 250.000 MAP

OF

THE GOLD COAST, ASHANTI, AND NORTHERN TERRITORIES.

Showing state of surveys, 31st March, 1913.

Diagram IV.



NORTH C-30

NORTH C-31

NORTH B-30

NORTH B-31

WA

NAVARRO

GAMBAGA

Gambaga

Walembele

Weussie

Kaisa

Sekelo

Wa

Zankano

Karaga

Dusi

Bungweli

Nabogo

Patenga

Sekwi

Ypala

Janfronu

DABOYA

Daboya

TAMALE

Tamale

Zan

Kpalbe

Nakpala

Bole

BOLE

Buipe

Donkokade

Salaga

SALAGA

BONDUKU

KINTAMPO

Yeji

Kintampo

Sikassiko

Abease

Wanki

Atabubu

Krachi

Nkoranza

SIKASSIKO

NKORANZA

ATABUBU

AKROSO

Odumase

Nkaneku

Akroso

Bonaso

Asikasoo

Pamu

Sekodumase

Mampong

Nkame

Coomassie

Adeambra

Abetifi

Afram River

Wope

Debiso

Ahuakru

Asafo

Bompata

Obo

Mpraeso

Dadiaso

Wiawoso

Ubuesi

Fumso

Kibbi

Komfrodua

Akuse

Odumase

Begoro

Kakorantuni

Dsoje

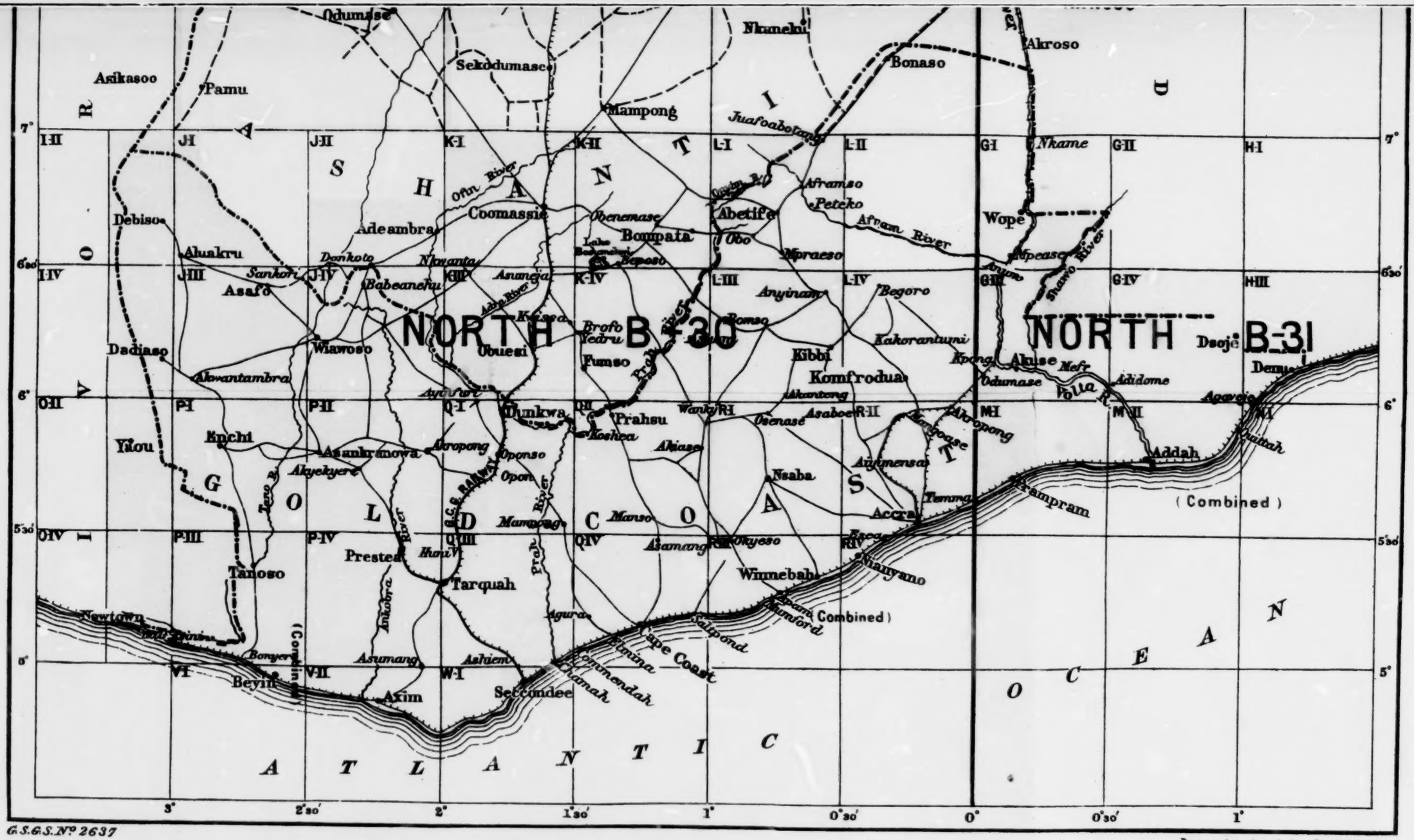
Volta River

Black Volta R.

Sene R.

Ofin River

Pra River


NORTH B-30
NORTH B-31
Odumasse
Asikasoo
Pamu
Sekodumasee
Mampong
Nkameki
Bonaso
Akroso
Nkame
Debiso
Ahuakru
Adeambra
Coomassie
Bompata
Abetifi
Peteko
Aframso
Afram River
Wope
Mpeaso
Shawo River
Denkoto
Nsuanta
Babeanehu
Asafo
Sankor
Asuaga
Anyinam
Begoro
Dadiaso
Wiawoso
Ubuesi
Fumso
Kibbi
Komfrodua
Kakorantuni
Akuse
Dsoje
Addidome
Odumase
Volta R.
Addah
Dentah
Agavegi
Yiiou
Kuchi
Asankranowa
Akyekyere
Akropong
Oponso
Opon
Prahsu
Koshea
Wanki
Osenase
Asaboe
Nsaba
Ajumensa
Accra
Tema
Krampram
(Combined)
Tanoso
Prested
Tarquah
Manso
Asamang
Okyeso
Winnebah
Mfantsiman
Newtown
Beyin
Axim
Asumang
Ashiem
Secondee
Agura
Cape Coast
Saltpond
Mumford
Elmina
Chamah
Ommendah
ATLANTIC OCEAN
(Combined)
(Combining)
Tano River
Ankobra
Prah River
Ofin River
Adda River
Densu River
A.C.G. RAILWAY
Akanteng
Kwanyako
Bonsa
Kesea
Brofo Edru
Anumga
Ayafuri
Mamaoag
Kwahu
Dunkwa
Tarkwa
Bonsa
Kwanyako
Akanteng

Between the 1st November, 1912, and the 31st March, 1913, the following work was finished :—

87·8 miles of rigid traverse,
147 miles of subtense traverse,
100·4 miles of chain and compass traverse,
217 miles of rope and compass traverse,
79·6 miles of levelling,
4,634 square miles topographically surveyed.

The following table gives the cost and speed of different classes of traverse in "dense orchard" country (*i.e.*, as dense as an average pine forest) :—

Nature of Traverse.	Cost.	Speed.	Average Length of Leg.
	£ a mile.	Miles a day.	Miles.
Rigid (along roads, no clearing) ...	2·15	2·18	0·5
„ (through bush)	3·56	1·09	0·5
Subtense	1·31	3·80	0·9
Secondary (chain and compass) ...	1·25	1·40	—
„ (rope and compass) ...	0·40	4·10	—

Levelling cost £1·2 a mile, and was done at 1·84 miles a day On broad, straight roads the rate rose to 3·52 miles a day.

The cost of rigid traversing in 1911 over a short distance with untrained boys was £5 a mile.

Rigid Traverses.—Great difficulty was experienced in the taping, especially with the native chainmen. It was found that the best results were obtained by using two taping parties, one in front of, and the other behind, the traversing officer. A check on gross errors was given by a bicycle wheel with a cyclometer, which could be read to tenths and estimated to hundredths of a mile, *i.e.*, accurately enough to check a 300-foot tape. With this method the total discrepancy between the two tapes was 1 in 14,000 over a length of 10 miles.

Although the rate of clearing (1·09 miles a day) was slower than that of traversing, the increase in the rate caused by putting a European in charge of the cutting party did not justify the increase in cost. Mirage was a great obstacle to rapid progress; it was often impossible to use a theodolite after 8.30 a.m. A strong harmattan also added to the difficulties.

Subtense traverses.—These were carried along the Volta and two tributaries. Mirage was avoided by keeping the stations well up the banks, and work was continued throughout the day.

Filling in detail.—The slowest rate was six square miles a day per man. One mile of traverse was necessary for every square mile surveyed.

Northern Ashanti.—The mapping of this district was taken over from the Intelligence Officer at Coomassie in the autumn of 1912.

The material has been examined, and it is found that certain rigid traverses are essential.

None of the Topographical Branch could be spared from the Northern Territories, and little has been done. Proposals for the rapid completion of the map will shortly be submitted.

Cadastral Branch.

The staff was below strength throughout the year owing to leave, and delays in replacing men whose tours of service were finished.

Concession Surveys.—The area surveyed was 89,982 acres. Work, at various stages, was done on 41 concessions, and there were only four untouched on March 31st, 1913. This reduction in arrears is due to increased output of work and withdrawals of orders for survey.

The demarcation of the Prah-Anum Government Preserve was finished, and certain lands were surveyed for the Courts.

Town Surveys.—These are undertaken by the Cadastral Branch in the wet season. The whole staff was concentrated at Cape Coast Castle, and the detailed survey of that town, on the scale of 1/1,000, was made.

The survey work was intricate, owing to large masses of dilapidated huts. The large-scale plan is in 14 sheets. A detailed survey of Akuse, in 16 sheets, was also made.

Large-scale surveys on the scale of 1/1,000, with reductions to the scale of 1/5,000, of the following towns have been made:—Accra, Seccondee, Coomassie, Tarquah, Dunkwa, Saltpond, Cape Coast Castle, Kibbi and Akuse.

Water Supply Surveys.—These were finished by October, 1912.

Special Work.

The Director of Surveys prepared a return showing the areas alienated under certificates of validity, together with the names of the lessors and lessees, the mining and occupation rents, &c. During the year 130·997 square miles in the Colony, and 43·617 square miles in Ashanti, were alienated, but certificates covering an area of ten square miles were afterwards cancelled.

The total increase in alienated land is therefore 164·614 square miles.

The Director of Surveys also enquired into the dispute about the boundaries between Eastern and Western Akim: it is hoped that the question will soon be settled.

Maps.

Map of the Colony ($\frac{1}{125000}$).—A revised edition is necessary, and will be undertaken as soon as staff and money can be found.

Map of Northern Ashanti ($\frac{1}{250000}$).—Draft sheets will be sent to England this year.

Map of the Northern Territories ($\frac{1}{250000}$).—It is hoped that provisional Salaga and Tamale sheets will be published in 1914.

Map of the Tarquah District ($\frac{1}{50000}$).—Sickness prevented the final drafts of this map from being made during the summer of 1912, as had been intended.

Cost.

The cost of the department was £15,382 4*s*., of which £1,225 9*s*. were spent on water supply and drainage schemes. There are no figures for revenue.

Of the above the following is a statement of proportional cost:—

	Per cent.
Salaries and allowances	47
Carriers	35
Passages and railway expenses	4
Stores	4
Miscellaneous	10
	100

The cost of different classes of survey is given on p. 23.

General Comment.

The work of this department is satisfactory, but has been delayed through shortage of staff.

NORTHERN NIGERIA.

Governor	Sir F. J. D. Lugard, G.C.M.G., C.B., D.S.O.
Acting Surveyor-General...	Major F. G. Guggisberg, C.M.G., R.E.
Officer in charge of Mines Survey Section.	Captain F. L. N. Giles, R.E.
Intelligence Officer ...	Captain H. G. Howell, R.A.
Chief Surveyor	Mr. A. S. Collard.

Organization of the Survey Department.

Headquarters	Chief Surveyor. 1 European draughtsman. 6 native draughtsmen.
Cadastral and Mines Survey	5 European surveyors (N.C.O.'s, R.E.).
Special Mines Survey Section	2 officers. 12 surveyors (11 N.C.O.'s, R.E.).

Present State of Topography.

Provisional sheets on the scale of $\frac{1}{250000}$, covering the whole of Northern Nigeria, have now been published.

The detail on all these sheets has been compiled from rough sketches adjusted to a framework of observed latitudes and telegraphic or absolute determinations of longitude. There has been no work which could be classed as topographical surveying, except along the international boundaries.

The Work of the Past Year.

Cadastral and Mines Survey.

For five months of the year the Chief Surveyor was the only member of the staff in the country, and the headquarters drawing office was without a European draughtsman for nine months.

The usual work of checking mining areas was continued, and surveys were made of the native town of Lokoja, and of the town and cantonment of Kano. The revenue survey of Kano was begun, the method being to run a theodolite traverse round the sub-district boundaries with cross traverses through the most populous parts.

In addition, the Chief Surveyor made a skeleton map of the cantonment and native town of Ibi, and obtained valuable information about the southern approaches to the Bauchi plateau and the country between Nassarawa and the Baro-Kano railway.

For four months three of the European surveyors helped the Southern Nigeria survey parties in preparing bases at Naraguta and Kano, beaconing the base extension at Kano, &c.

Special Mines Survey Section.

A special survey of the tin mining area round Bauchi, Naraguta and Bukuru was approved in September, 1912.

Delay was caused by indistinct boundaries and the absence of mine beacons, as well as by sickness, which alone deprived the section of over a fifth of its working days. The greatest source of difficulty, however, was the labour question. The demand of the mines is very heavy, and the mining companies house their boys, which the survey parties obviously cannot do. This makes it unlikely that the survey parties will be able to compete with the mines when the rains begin. As it is, more than half the carriers leave at the end of a month. This not only means a loss of time in beating up recruits, but prevents any systematic training of chainmen, and so hampers the surveyors still further.

Mines Surveyed.—The task given to the section was the survey of about 1,000 square miles of lands held under exclusive licences to prospect, and of about 48,000 acres held under mining leases, all within the area of the mine-field, which is bounded by 9° and 11° 15′ north latitude and 8° and 9° 45′ east longitude. All these lands had previously been surveyed by the mining companies, but the methods were so varied that there was likely to be much confusion.

In October, 1912, therefore, the area was closed for the issue of further licences, with certain exceptions, until an accurate survey should have been made by the Government.

Up to the end of March, 1913, the section had surveyed 100 square miles. It is probable that the original scheme could be finished by February, 1914, but, since the formation of the section, 109 applications for new lands within the area of the mine-field have been received.

System of Survey.—The licences are surveyed by compass, the mining leases by theodolite, traverse. All detail within the latter is mapped, and topographical detail on the boundaries of the former.

All mine surveys are tied to a triangulation framework either by interpolation with the theodolite or by theodolite traverses.

The framework, extended from an invar catenary base-measurement, covers unfortunately only a small area. An extension is essential, but it has hitherto been impossible to spare either of the officers from supervision and office work.

Maps and records.—The officer in charge of the section keeps field sheets on the scale of $\frac{1}{62500}$ (a quarter degree square, on which all mine surveys (licences on the scale of $\frac{1}{25000}$, leases on $\frac{1}{6250}$) are plotted, after reduction, as soon as they are sent in from the camps.

It is probable that much of the topographical work on the boundaries of the prospecting licences in the mines district will be lost, as many such areas are likely to be abandoned, and their boundaries effaced.

General Comment.

The survey staff appears at present inadequate to meet the demands upon it.

SOUTHERN NIGERIA.

Governor	Sir F. J. D. Lugard, G.C.M.G. C.B., D.S.O.
Director of Surveys	Major F. G. Guggisberg C.M.G., R.E.
Deputy Director of Surveys ...	Mr. A. Cleminson.
Deputy Director, Topographical Branch	Captain R. H. Rowe, R.A.
Assistant Directors, Topographical Branch.	Lieut. G. G. Waterhouse, R.E.
	Lieut. H. E. Kentish, R.E.
	Lieut. G. H. Bell, S. Lancs. Regt.
	Lieut. J. Dare, L.N. Lancs. Regt.

Organization of the Survey Department.

Headquarters	Director of Surveys. Office Superintendent. 1 European clerk. 3 native clerks.
Topographical Branch ...	Deputy Director. 4 officers. 10 European surveyors (9 N.C.O.'s, R.E.). 12 native surveyors. 1 native map curator. 5 native draughtsmen.
Cadastral Branch ...	Deputy Director of Surveys. 2 lands surveyors. 1 European draughtsman (N.C.O., R.E.). Superintendent, Special Cadastral Party. 6 European surveyors (N.C.O.'s, R.E.), Special Cadastral Party. 4 native surveyors. 5 native draughtsmen. 1 native clerk.
School and Meteorological Branch.	Chief Instructor. 2 meteorological native clerks. 23 pupils and probationer pupils.

Present state of Topography.

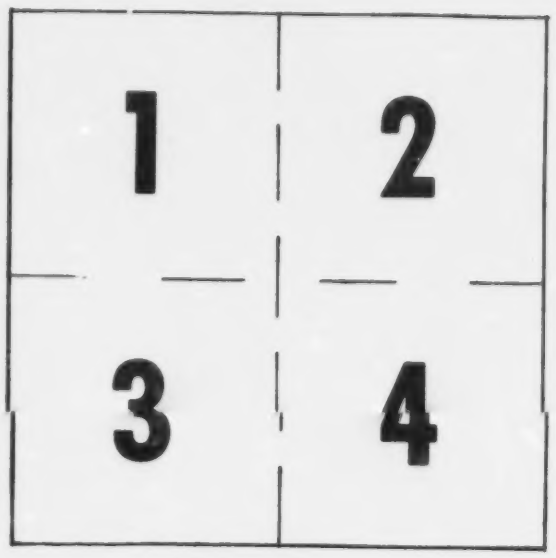
This is shown on **Diagram V.**

The Work of the past Year.

Topographical Branch.

Trigonometrical Section.—In October, 1912, the section was divided into two groups. One group went to Northern Nigeria and measured bases, using invar in catenary, at Naraguta for the mines survey and at Kano for the revenue survey, triangulated a small area round each base, and made a reconnaissance from Kano to Naraguta. The other group finished the minor triangulation, near Ogbomosho, which the topographical section would want towards the end of the season, and made a reconnaissance towards Lokoja. In March, 1913, the Section moved to the Central and Eastern Provinces to measure a base and make a triangulation framework for the topographical survey of the Udi coalfields and Uwet tinfields during the next field season. The latter base and the two bases in Northern Nigeria will eventually be check bases, when the four separate triangulation areas are connected. From a purely technical point of view the dispersal of the triangulation is regretted, but local demands made it inevitable.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.



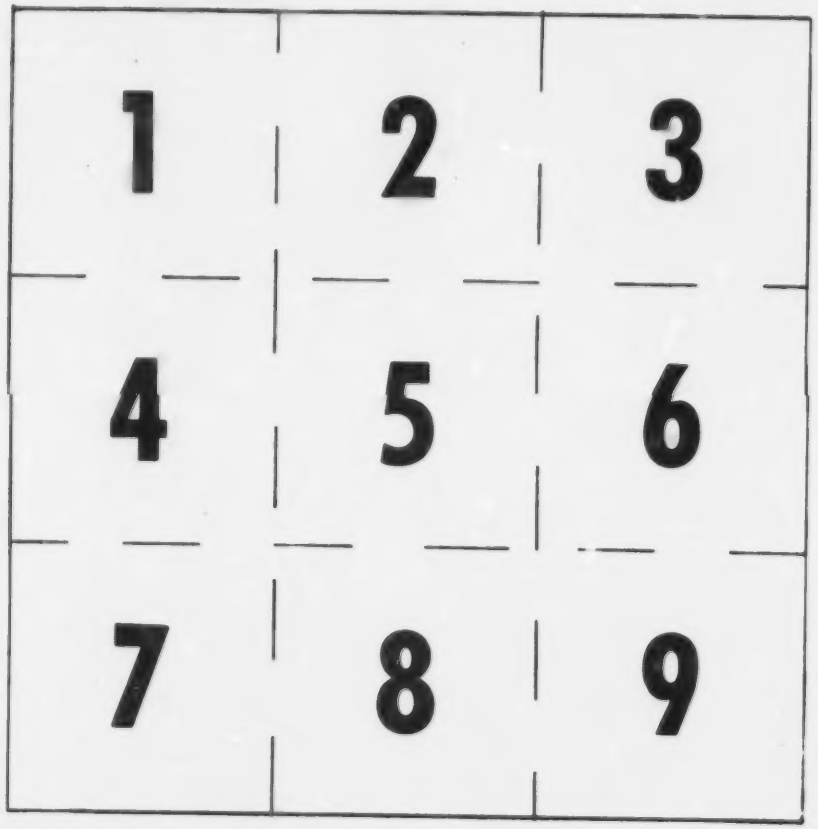
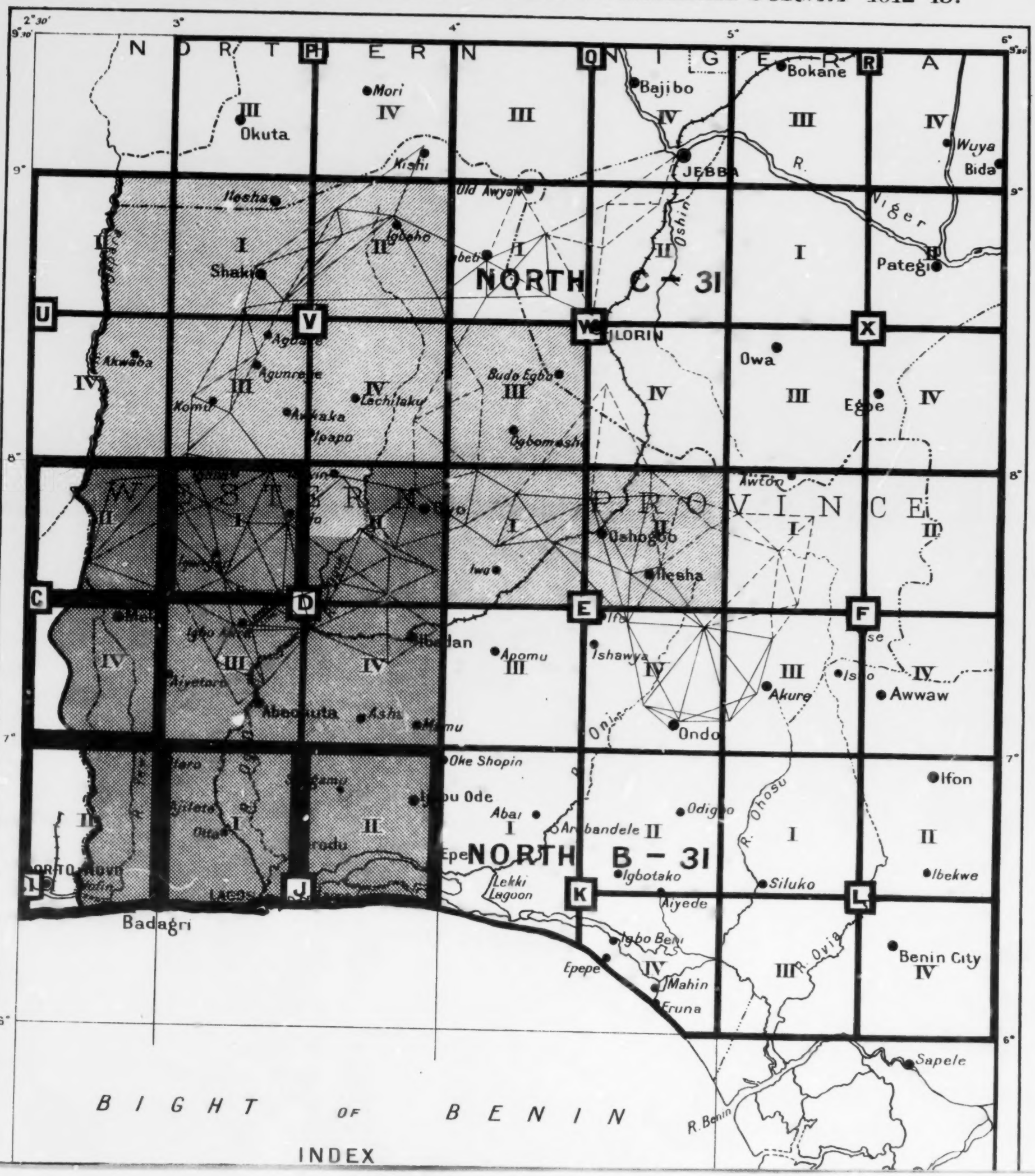


Diagram V.

MAP FOR ANNUAL REPORT OF SOUTHERN NIGERIA SURVEY 1912-13.



INDEX
TO THE
1:125,000 SURVEY
OF
SOUTHERN NIGERIA.

Scale 1/2,000,000 or 1·014 Inches to 32 Miles.

Miles 50 40 30 20 10 0 50 Miles

Explanation

Area covered by previous Triangulation
Area covered by Triangulation 1911-1912
Area beaconed for 1912-1913
Area previously surveyed
Area completely Topographically surveyed 1911-1912
Standard Sheets published
Standard sheets to be published on scale of 1:125,000.
Boundary International
Boundary Intercolonial
Railways

NORTH B - 31

BIGHT OF BENIN

From information furnished by
Major F. G. Guggisberg C.M.G. R.E.
Director of Surveys.

Geographical Section, General Staff No 2583.

War Office, Aug, 1913.

The experience of the last two seasons has made it necessary to postpone the beginning of the field season of the Section from October to November, in order to avoid the harmattan.

Topographical Section.—During the recess a field camp of native surveyors extended the traverse framework eastward along the coast, while the remainder of the native staff were attached to the Cadastral Branch for the instrumental levelling and the detail work of the 88 ft. sheets of Lagos.

In October, 1912, the section, in two groups, began the survey of 11 standard sheets. Good progress was made, and, by March 31st, 1913, more than 6,000 square miles had been surveyed, and five sheets had been sent to the publishers.

Programme for 1913–14.—Both sections of the Topographical Branch leave the Western Province at the end of this season and begin the topographical survey of the Central and Eastern Provinces, where the discovery of coal and tin fields makes it essential to provide the Administration with a contoured map, to assist in the early development of the country.

Cadastral Branch.

Western Province.—During the recess good progress was made with the instrumental levelling and the detail work of the 88-foot sheets outside Lagos town. During the field season the special cadastral party, reduced to six surveyors, continued the detail survey of Lagos. Although the party was much handicapped by sickness, eight sheets were finished by December 31st, and ten sheets outside Lagos town were sufficiently mapped by compass surveys, based on theodolite traverses, to be ready for publication by the end of March, 1913.

Central Province.—The Provincial Lands Survey Section was formed in July, 1912, with headquarters at Warri. Good progress was made with the traverse framework of Warri town, and 64½ acres of detail survey were finished. No surveys could be made in the country owing to the heavy rains.

Eastern Province.—The framework of Calabar town was finished in December, 1912, 260 concrete cubes being used to mark the traverse stations. The detail work was much hindered by the lack of a sufficient staff, but a satisfactory amount was done in the native town. Fourteen surveys of country lands were also made.

Mines Section.—This was formed in February, 1913, for the survey of lands held under exclusive licences to prospect and mining leases near Uwet, Eastern Province. The section will begin the triangulation framework from Calabar to Uwet, so that the surveys of the different properties may be tied to it as applications come in. This work will be taken over by the trigonometrical section in April, 1913. The mines section will be increased in October, 1913, by the transfer of two European surveyors and a chief native surveyor from the topographical branch, to meet the demands for the survey of mining leases.

It will also be assisted by the topographical branch, which will survey the lands held under prospecting licences which lie within the area of the mines section's work.

School and Meteorological Branch.

Five pupils were appointed as surveyors and three as draughtsmen during 1912. One senior and two middle class pupils were dismissed for misconduct or incompetence. Nine pupils were admitted in October, 1912, after a probationary course of three months. The system of attaching the two senior classes to the topographical branch for field training is giving good results; the nature of the work under the personal supervision of the camp officers discovers the character of the pupils and allows the unsatisfactory ones to be weeded out before they are appointed surveyors. Five were dismissed in 1912. Observations were made and meteorological returns were compiled at 35 stations.

Special Work.

The topographical branch located and marked temporarily, pending decision by the Government, the boundaries of administrative districts and forest reserves in the area of the season's work. The same branch also made topographical surveys of Government stations, various lands held under leases, and important towns in the season's area.

The cadastral branch made observations for the daily transmission, through the Director of Telegraphs, of Lagos time thoughout the Colony and Protectorate.

The headquarters office had much work to do in connection with Northern Nigeria. Proposals to meet the demand for surveys were drawn up; they included not only the general organization of a survey department, but also the formation of a school to provide native surveyors for the survey and assessment of the densely populated agricultural area in Kano Province, the formation of a revenue section, and of a mines survey section for the tin mines round Bauchi, Bukuru and Naraguta.

The Publication of Maps.

The topographical sheets are shown on Diagram V. A conventional sign sheet for cadastral surveys and a revised 5-chain plan of Lagos were published. Five sheets of the detail map of Lagos (provisional series, 1 inch = 88 feet) were sent to the publishers, and thirteen sheets go home in April.

The delay in the publication of the topographical sheets, mainly due to the time spent in sending proofs from England to the Colony and back, has been most inconvenient, but reproduction will be quicker in future. Under the most favourable circumstances it seems unlikely that a sheet will be published within a year of the time when it is finished in the field. In addition to this a consignment of published sheets from the printer takes from six weeks to two months to reach Lagos.

In order to hasten publication and to effect economy, the method of engraving the standard sheets on copper plates in five colours has, for certain sheets in unimportant and thinly inhabited areas, been altered to photo-lithography in black only.

General Comment.

The survey department of Southern Nigeria continues to do excellent work, and is efficient in every respect.

NYASALAND.

Governor	Mr. George Smith, C.M.G.
Director of Public Works ...	Mr. T. I. Binnie.
Assistant Director of Public Works...	Mr. T. F. Firr.
Assistant Surveyor	Mr. J. Bannerman.

Organization of the Survey Department.

All survey work is done by the Public Works Department, but the Assistant Surveyor is the only officer who is permanently employed on survey work. A proposal has been submitted to make a separate survey department, to be called the Lands Office, with the following staff:—

One lands officer and conveyancer,
Two surveyors.

Present State of Topography.

Eleven provisional sheets on the scale of $\frac{1}{250000}$, based on rough sketches, have been published, but no systematic topographical survey has been attempted.

The Work of the Past Year.

Field.

No trigonometrical or topographical work was done.

Cadastral Surveys.—The work was seriously hindered by the illness of the one surveyor, who contracted blackwater fever in August, 1912, and has since been invalided from the service.

The following estates were surveyed.

District.	Area in Acres.	Nature of Estate.
Lower Shire District	350	Cotton.
	78½	„
	2,000	Government experimental farm.
	50	Mission.
Mlanje District ...	600	Reduction from 737 acres.
	320	Cotton and Tobacco.
	500	Tobacco.
	2,000	Tea (Exchange).
	90	„
Total ...	5,988½	

In addition, 625 chains of old boundary were re-surveyed in the Blantyre District, a traverse was run for 20 miles along the Shire river, and a road traverse was run for 47 miles in the Lower Shire District. The two latter traverses were required for a large-scale map of the district, and for connecting various estates.

There are still large arrears of estates to be surveyed.

Office.

45 plans and 105 tracings were prepared, and 36 small-scale plans were endorsed on deeds.

Cost.

The cost of the department was £966.

The proportional cost was as follows :—

	Per cent.
Salaries and allowances	78
Passages	11
Carriers, linesmen	6
Instruments and stores	5
	100

SIERRA LEONE.

Governor ... ... Sir E. M. Merewether, K.C.V.O., C.M.G.

On the application of the Governor it was decided to begin, in 1912, a cadastral survey of Freetown on the scale of 1/2,500, as the basis for a system of street construction and drainage; the survey will also serve other purposes.

An Ordnance Survey party, consisting of Captain G. A. P. Brown and four N.C.O.'s, R.E., began work in October, 1912. Captain Brown remained in Freetown for six weeks to start the work, and then returned to England, leaving Ex-C. S. M. McGregor in charge.

The framework of the survey is a network of rigorous traverses which has been systematically reduced by the method of least squares.

At the beginning of the wet season of 1913, Ex-C. S. M. McGregor and the three N.C.O.'s, R.E., returned to England. A similarly constituted party sailed for Freetown in September, 1913, to continue the survey.

UGANDA.

Governor	Sir F. J. JACKSON, K.C.M.G., C.B.
Director of Surveys and Land Officer...	Mr. R. C. ALLEN.
Deputy Director of Surveys ...	Mr. H. BOAZMAN.

ORGANIZATION OF THE SURVEY DEPARTMENT.

Headquarters	Director of Surveys. Deputy Director of Surveys. 1 European surveyor. 2 European clerks. 1 European draughtsman. 2 Indian clerks. 2 Indian draughtsmen.
Native Estate Surveys in Buganda.	10 European surveyors. 1 Indian assistant surveyor.
Crown lands surveys	2 European surveyors.

Compared with the previous year, the staff has been increased by 1 European surveyor and 1 European clerk, and decreased by 1 European draughtsman. In August, 1912, the Deputy Director of Surveys, Mr. W. V. Morris, resigned, and his successor, Mr. H. Boazman, has also tendered his resignation. The loss of two such senior and capable officers within 12 months is a serious blow to the department.

PRESENT STATE OF TOPOGRAPHY.

This is shown on Diagram III.

THE WORK OF THE PAST YEAR.

Triangulation and Topography.—The members of the Anglo-German and Anglo-Belgian Boundary Commission continued the topographical survey of the Western Province until the end of June, 1912, when the money that had been allotted for the survey was exhausted. The party had mapped an area of 3,446 sq. miles since the middle of November, 1911. The Mbarara sheet, South $\frac{A\text{-}36}{A}$ was finished except for 142 sq. miles, which will, it is hoped, be mapped by an officer of the King's African Rifles.

Native Estate Surveys.—This work is done in accordance with the provisions of the Buganda Agreement of 1900.

The area over which theodolite observations, at points about 1 mile apart, were finished was 885 sq. miles (1,054 sq. miles in 1911–12). The *total* area over which points have been fixed is 4,372 sq. miles.

The area of which the detail was mapped was 704 sq. miles (908 sq. miles in 1911–12).

The *total* area surveyed is now 3,987 sq. miles.

The decrease in work compared with the previous year is due to various causes—a greater number of days (1,501, *i.e.*, over 4 men-years) lost through leave and delays in filling vacancies, a greater number of assistants at headquarters owing to the increase in Land Office work. and the inability of the two Crown land surveyors to meet the demands made upon them, necessitating calls upon native estate surveyors, and a consequent disorganization of field parties.

Crown Land Surveys.—Two surveyors were employed exclusively on these, including townships. Other surveyors also did 12 men-months' work at various times on these surveys. Most of the time was spent on township surveys. Apart from townships the area surveyed was 13,500 acres.

Township Surveys.—There has been a keen demand for township plots both for trading and residence, especially at Kampala and Jinja. The construction of the Busoga railway has led to the laying out of new townships at Namasagali (the railway terminus on the Nile), at Bugondo (a port on Lake Kioga) and at Soroti, the new headquarters of the Bukedi district.

Surveys have also been made of Mbarara, the capital of Ankole, and of Masindi, the new capital of the Northern Province, and the survey of Masaka has been augmented and revised.

Land Office.—The number of leases and grants of land during the year, other than grants to natives under the Buganda Agreement of 1900, amounted to 117 (77 in 1911–12, 27 in 1910–11).

Cost.

Expenditure and Revenue.—Final figures cannot be given. The approximate expenditure up to 31st March, 1913, was £7,813 (£9,081 estimated). The revenue up to 31st December, 1912, was £4,641, the greater part of this being land rents.

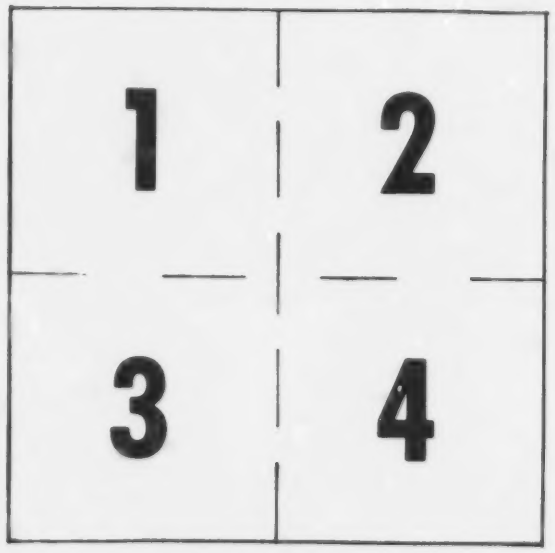
Different Classes of Survey.—The cost of *native estate surveys*, excluding the expenditure on headquarters, was £6 14*s.* per sq. lime (£5 2*s.* in 1911–12), or 2·52*d.* per acre.

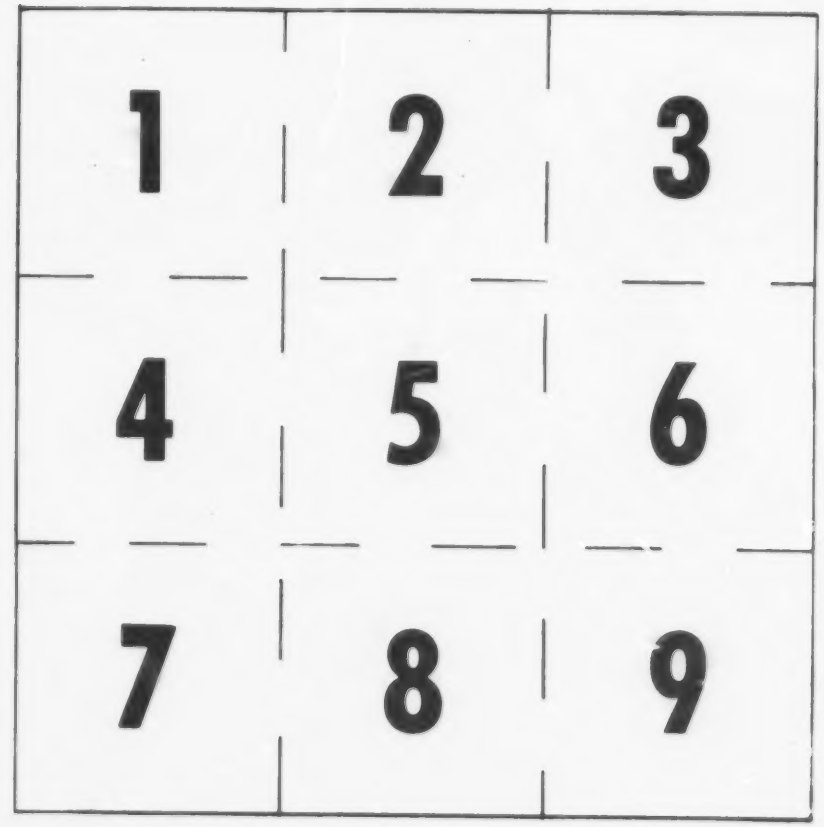
The cost of *Crown lands surveys* was roughly £20 per sq. mile.

General Comment.

The important work of surveying native estates is progressing satisfactorily, but it would seem desirable that the number of Crown Land Surveyors should be increased.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.





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to the sheets of

SOUTH AFRICAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

Miles 50 0 50 100 150 200 Miles

REFERENCE

Field sheets completed.....
Sheets published.....
Red names shew names of sheets.

16° 17° 18° 19° 20° 21° 22° 23° 24° 25° 26° 27° 28° 29° 30°

22° 23° 24° 25° 26° 27° 28° 29° 30°

SOUTH F-35

SOUTH G-35

SOUTH H-33

SOUTH H-34

SOUTH H-35

GERMAN SOUTH WEST AFRICA

BECHUANALAND

TRANSVAAL

ORANGE FREE STATE

NATAL

BASUTOLAND

RHODES' DRIFT

ZOUTPANS

PALAGYE

MAGALAKWIN

N. PONGOLA FLATS

BLAAUWBERG

PIETERSBURG

LEYDSD

Marabastad

Louis Trichardt

Lotsani R.

Limpopo R.

Motwani R.

Mochudi

Gaberones

DERDEPOORT

KRANTZBERG

WYLSTROOM

GELUK

OHRIGST

MIDDELBURG

MACHADODORP

MAFEKING

MARIBOGO

Lichtenburg

Vryburg

Taungs

VREDEFORT

FRANKFORT

HEILBRON

KROONSTAD

LINDLEY

VREDE

UTRECHT

AMSTERDAM

STANDERTON

BLOEMHOF

HOOPSTAD

WINBURG

SENEKAL

BOSHOF

KIMBERLEY

GRIQUATOWN

DOUGLAS

HOPETOWN

PHILIPPOLIS

BLOEMFONTEIN

LADYBRAND

FICKSBURG

HARRISMITH

BETHLEHEM

WITTEBERGEN

LADYSMITH

DUNDEE

GREYTOWN

ORANGE RIVER MOUTH

STINKFONTEIN

WARMBAD

SCUIT DRIFT

UPINGTON

KAKAMAS

LANGEBURG

PRIESKA

KENHARDT

PELLA

LITTLE BUSHMAN LAND

ODE TUIN

OOKIEP

PORT NOLLOTH

BOWESDORP

STRYDENBURG

EDENBURG

WEPENER

SMITHFIELD

RICHMOND

BULWER

SUTHERLAND

WESTON

COLENSO

LYDENBURG

INDEX

to the sheets of

CAN TOPOGRAPHICAL SURVEYS

on scales of $\frac{1}{250,000}$ and $\frac{1}{125,000}$

Scale $\frac{1}{4,000,000}$

0 50 100 150 200 Miles

REFERENCE

Field sheets completed.....

Sheets published.....

Red names shew names of sheets.

19° 20° 21° 22° 23° 24° 25° 26° 27° 28° 29° 30° 31° 32° 33°

22° 23° 24° 25° 26° 27° 28° 29°

SOUTH F - 35

SOUTH F - 36

SOUTH G - 35

SOUTH G - 36

SOUTH H - 34

SOUTH H - 35

SOUTH H - 36

BECHUANALAND

TRANSVAAL

ORANGE FREE STATE

NATAL

SOUTH WEST AFRICA

PORTUGUESE

RHODES' DRIFT

ZOUTPANSBERG

PAFURI

LETABA

PIETERSBURG

LEYDSDORP

UMBABAT

GELUK

OHRIGSTA

KOMATI POORT

MIDDELBURG

MACHADODORP

AMSTERDAM

SWAZILAND

BREMERSDORP

PALAPYE

MAGALAKWYN

N. POMGOLA FLATS

BLAAUWBERG

LOUIS TRICHARD

DERDEPOORT

KRANTZBERG

WYLSTROOM

LYDENBURG

PILGRIMS REST

LICHTENBURG

MAFEKING

MARIBOGO

VRYBURG

VREDEFORT

FRANKFORT

HEILBRON

KROONSTAD

BLOEMHOF

HOOPSTAD

LINDLEY

VREDE

UTRECHT

SCUIT DRIFT

UPINGTON

LANGEBURG

KAKAMAS

GRIQUATOWN

KIMBERLEY

BOSHOF

WINBURG

SENEKAL

FICKSBURG

BETHLEHEM

HARRISMITH

LADYBRAND

BLOEMFONTEIN

TWEEBRONNEN

THABANCHU

KENHARDT

PELLA

ODE RUIN

PRIESKA

DOUGLAS

HOPETOWN

STRYDENBURG

EDENBURG

WEPENER

SMITHFIELD

PHILIPPOLIS

ROBERTSON

LITTLE BUSHMAN LAND

ARMBADA

BASUTOLAND

N.W.

N.E.

S.E.

S.W.

ROBERTS DRIFT

LADYSMITH

DUNDEE

GLENCOE

NEWCASTLE

WAKKERSTROOM

VOLKSRUST

STANGER

PIETERMARITZBURG

RICHMOND

BULWER

SUTHERLAND

WESTON

GREYTOWN

COLENSO

ESTCOURT

UMBOMBO

ZULULAND

ST LUCIA BAY

ST LUCIA LAKE

USUTU RIVER (SOUTH)

LOURENÇO MARQUES

BARBERTON

CAROLINA

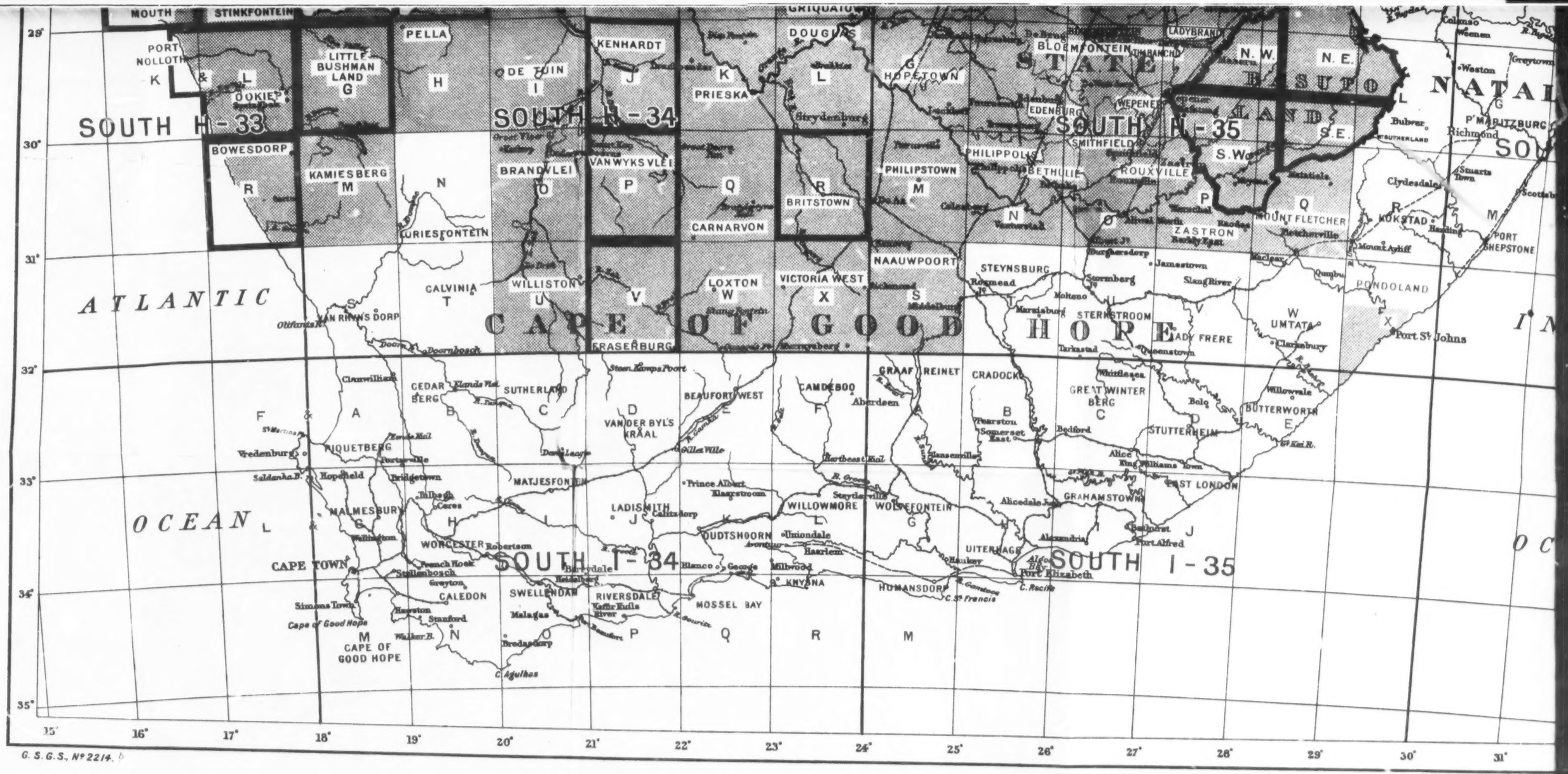
BETHAL

ERMELO

DAVEL

WITBANK

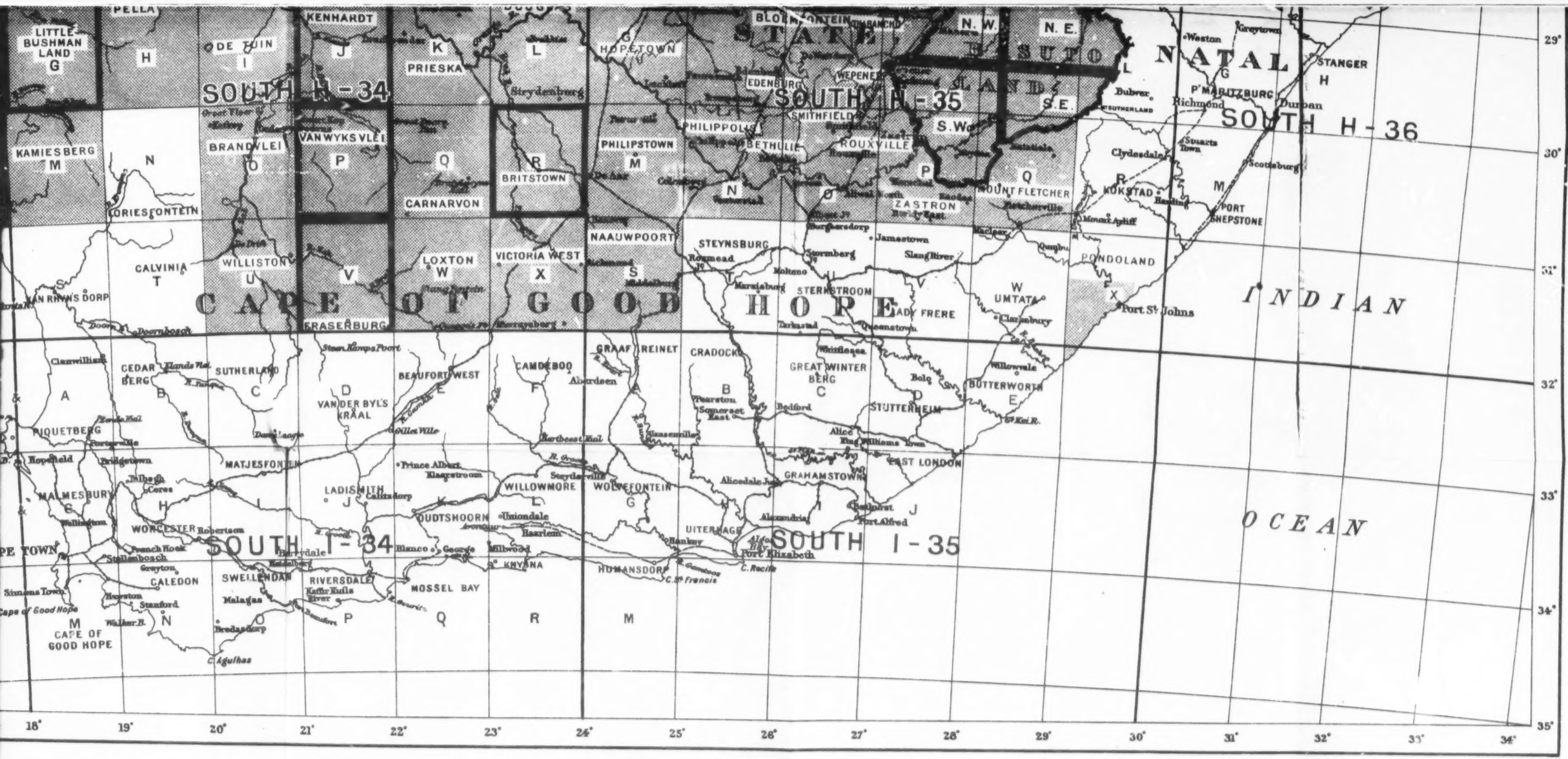
DELAGOA BAY



G. S. G. S., Nº 2214. b

Compiled in the Geographical Section, General Staff.

1906


LITTLE BUSHMAN LAND
PELLA
KENHARDT
DE TUIN
PRIESKA
Strydenburg
HOPETOWN
BLOEMFONTEIN
SOUTH H-34
SOUTH H-35
N.W.
N.E.
S.W.
S.E.
WEPENER
EDENBURG
SMITHFIELD
PHILIPPOLIS
PHILIPSTOWN
BETHULIE
ROUXVILLE
ZASTRON
MOUNT FLETCHER
Weston
Greytown
NATAL
STANGER
Bulwer
Richmond
P'MARITZBURG
Durban
SOUTH H-36
Clydesdale
Stuarts Town
Scottsburg
KOKSTAD
PORT SHEPSTONE
KAMIESBERG
BRANDVLEI
VAN WYKS VLEI
BRITSTOWN
CARNARVON
CALVINIA
WILLISTON
LOXTON
VICTORIA WEST
NAAUWPOORT
STEYNSBURG
Rosmead
Jamestown
Stormberg
Slang River
Molteno
Burgersdorp
Maclear
Qumbu
PONDOLAND
Port St Johns
INDIAN
CAPE OF GOOD HOPE
VAN RHYNS DORP
FRASERBURG
Marsieburg
STERKSTROOM
LADY FRERE
UMTATA
Clarkebury
Queenstown
Tarkastad
Whittlesea
Willowvale
Doorn R.
Doornbosch
GRAAF REINET
CRADOCK
GREAT WINTER BERG
BUTTERWORTH
Clanwilliam
CEDAR BERG
SUTHERLAND
BEAUFORT WEST
CAMDEBOO
Aberdeen
Pearston
Somerset East
Bedford
STUTTERHEIM
Alice
King Williams Town
Bolo
Keiskamma Hoek
Gt Kei R.
PIQUETBERG
Hopefield
Bridgetown
MATJESFONTEIN
Prince Albert
Klaarstroom
Beaufort West
Aberdeen
Cradock
Graaf Reinet
Somerset East
Bedford
Alice
King Williams Town
EAST LONDON
GRAHAMSTOWN
Alicedale
Port Alfred
Alexandria
Uitenhage
Port Elizabeth
Humansdorp
C. Recife
C. St Francis
Algoa Bay
Hankey
Knysna
Mossel Bay
George
Millwood
Riversdale
Swellendam
Caledon
Malagas
Stanford
Greyton
Stellenbosch
French Hoek
Paarl
Wellington
Worcester
Robertson
Ceres
Tulbagh
Malmesbury
Cape Town
Simons Town
Cape of Good Hope
C. Agulhas
Walker R.
Breda sdorp
Heidelberg
Barrydale
Riversdale
Keiskamma River
Knysna
Humansdorp
Uitenhage
Alexandria
Port Alfred
Grahamstown
East London
Alice
Bedford
Somerset East
Pearston
Cradock
Graaf Reinet
Aberdeen
Camdeboo
Beaufort West
Sutherland
Cedar Berg
Clanwilliam
Piquetberg
Hopefield
Bridgetown
Matjesfontein
Malmesbury
Worcester
Robertson
Ceres
Tulbagh
Wellington
Paarl
French Hoek
Stellenbosch
Caledon
Swellendam
Malagas
Stanford
Greyton
Heidelberg
Riversdale
Mossel Bay
George
Millwood

UNION OF SOUTH AFRICA.

State of the Military Surveys.

Diagram VI shows the sheets that have been published. Every sheet which has not yet been printed is now being reproduced. It is expected that the Cape of Good Hope and the Transvaal areas will be finished early in 1914, and the Orange Free State by the end of 1914. The sheets of the Orange Free State will be published by districts, not in half degree squares.

It will be seen from Diagram VI that the topographical survey of the Orange Free State is finished, but that Natal and large areas in the Cape of Good Hope and the Transvaal have not yet been systematically surveyed, and of these areas there are no reliable maps on any topographical scale.

So much has been done that it would be the greatest pity if the survey of South Africa were to be left in its present state.

IV.

THE STATE OF THE SURVEYS

OF

BRITISH HONDURAS, CEYLON, CYPRUS, FIJI, HONG KONG, JAMAICA, MALAY STATES AND TRINIDAD.

BRITISH HONDURAS.

Governor	Mr. W. COLLET, C.M.G.
Surveyor General	Mr. H. I. PERKINS.
Assistant Surveyor General	Mr. W. H. CARLIN.

Organization of the Survey Department.

Headquarters	Surveyor General. Assistant Surveyor General. 1 clerk. 1 tracer.
Cadastral Surveys	4 European surveyors.

There are also two forest officers in the department.

Present State of Topography.

No systematic survey has yet been made. All the evils which are attendant on patchwork survey may therefore be anticipated. These evils have been foreseen and a systematic survey has been recommended, but hitherto there has been no money for it.

The Work of the Past Year.

Trigonometrical Branch.—None.

Topographical Branch.—None.

Cadastral Branch.—In the Carib Reserve at Stann Creek, two surveyors, one for the whole year, the other from the middle of November till the end of the year, were employed in laying out 5-acre plots, involving the cutting of 30 miles of tie lines. In addition, some 3,600 acres were surveyed in various places, and 11 miles of traverse were run.

The arrears are small.

Cost.

Expenditure and Revenue.—The expenditure was roughly £4,000 (£4,657 estimated), and the revenue, mainly from timber licenses and sale of Crown lands, was roughly £9,240. It is impossible to give the survey figures only, as the survey, forest and land offices are all in one department.

The proportional cost was :—

	Per cent.
Salaries and allowances	77
Expenses of surveys	20
Rent, instruments and miscellaneous ...	3
	100

CEYLON.

Governor	Colonel Sir H. E. McCallum, G.C.M.G.
Surveyor General	Mr. R. S. Templeton.
Deputy Surveyor General	Mr. W. C. S. Ingles.

Organization of the Survey Department.

Field	9 Superintendents of Surveys (1 temporary).
	1 Superintendent, Observatory.
	1 Assistant Astronomer.
	33 Assistant Superintendents of Surveys (23 temporary).
	2 levellers.
	33 grade surveyors.
	234 supernumerary surveyors.

Office ... ...
- 7 Assistant Superintendents of Surveys (temporary).
- 117 clerks and draughtsmen.
- 1 accountant.
- 241 pieceworkers.
- 15 volunteers.

Present State of Topography.

Maps of the Northern Province, North Central Province and Province of Uva have now been published on the scales of 1 inch to 1 mile and $\frac{1}{4}$ inch to 1 mile. The area so published is 14,500 sq. miles.

Some 5,300 sq. miles have also been mapped in the North Western and Central Provinces, and the $\frac{1}{4}$-inch map of this area will soon be published.

None of the above maps can, strictly speaking, be classified as *topographical* maps, as no hill features are shown.

The Work of the Past Year.

Triangulation.—No field work was done ; some diagram work was done in the office.

Topography.—It is not clear how much was done during the year. The field work of the North Western Province and the Central Province has now been finished, excluding hill features.

Block Surveys.—During the year 41,000 acres were surveyed (79,000 in 1911–12). The large decrease compared with the previous year is due to the employment of the majority of the staff on settlement surveys, and on demarcating with landmarks lots which had been sold in the areas already block surveyed.

The landmarking threw much extra work on the department ; fortunately the staff had been largely increased.

Levelling.—120 miles of levels were run in duplicate (124 in 1911–12), and 388 bench marks were established.

Cost.

The cost of the department was roughly £129,616 (£84,080 in 1911–12). The proportional cost was :—

	Per cent.
Personal emoluments	50
Other charges	41
Special expenditure	9
	100

The estimate was roughly £165,974.

CYPRUS.

High Commissioner	...	Major Sir H. J. Goold-Adams, G.C.M.G., C.B.
Registrar General and Director of Surveys.		Mr. F. Ongley.
Assistant Director of Surveys.		Mr. B. T. Watts.

Organization of the Survey Department.

Field.

Trigonometrical Section	...	1 Chief Surveyor (3rd order triangulation). 1 Assistant (reconnaissance). 3 traversers (to connect trigonometrical points). 1 surveyor (4th order triangulation and detail survey).
Detail Survey Section	...	1 Chief Surveyor. 1 Assistant. 6 surveyors (1 on probation).

Office.

Headquarters	... ...	Director of Surveys. Assistant Director of Surveys 1 clerk and storekeeper.
Computation Office	... ...	1 surveyor. 1 surveyor on probation. 2 clerks.
Drawing Office	... ...	5 draughtsmen. 1 clerk (sun-printing and checking traces).

Present State of Topography.

Hitherto the only topographical map of the island has been the 1-inch map reproduced from a survey by Captain (now F. M. Viscount) Kitchener, R.E., and published in 1885. No topographical survey is being made, but the $\frac{1}{2500}$ sheets are now being reduced to form a topographical map on the scale of 4 inches to 1 mile.

Twenty-two such sheets have been reduced during the past year.

The Work of the Past Year.

Trigonometrical Section.

Bases.—To avoid waiting for the finish of the major triangulation, a triangulation of the Carpas was begun in December, 1911. Two bases were measured, but the steel tape, which was sent to England to be standardized, was lost in the wreck of the s.s. "Oceana."

New bases were measured with Jäderin wires, borrowed from the Egyptian survey, at Patriki and Armiridia for the Carpas triangulation, and at Famagusta and Papho for the major triangulation. The results of the standardization of the wires did not reach Cyprus till the end of October, 1912.

The base measurements were:—

	Feet.
Patriki	4606·587 4606·591
Armiridia	3287·2397 3287·2246
Famagusta	10235·8417 10235·8214
Papho	9574·5734 9574·2256

Triangulation.—The observations of the Carpas triangulation made in 1912 were rejected.

A new reconnaissance and new observations were begun at the end of May, 1912.

Re-observation was again necessary at many points, as the triangular error often exceeded the limit of 8″ (extended, for a few triangles near the sea, to 10″). It is stated that the large errors were due to rough handling during transport, which put the instruments out of adjustment.

The large expanse of forest made it very difficult to get well-conditioned triangles.

An attempt was made in July and August, 1912, to extend the Famagusta base in order to connect it with the Carpas triangulation, and so to transfer to the latter a value for longitude, based on the flagstaff at Famagusta. This attempt failed through constant mists both in the valleys and on the hills, but the extension was made in November and December.

Observations for latitude and azimuth were made at the south end of the Patriki base.

The 3rd order triangulation was broken down into 4th order triangles, points from ¾ to 1 mile apart, observations being taken from these to either four 3rd order points, or three 3rd order and one 4th order point.

On the Carpas triangulation observations were taken at 81 3rd order and 95 4th order points. The average triangular error in the 3rd order triangulation was 4·05″.

Traverses.—The staff had to be trained to this work. Each surveyor observed with a 5-inch Cooke theodolite, and was ordered to chain each line twice.

When the computations were done, some of the work would not close within reasonable limits. It was found that this was due to single chaining of the lines, false measurements having been sent in for second chainings.

It was also found that the chains stretched considerably, and that the surveyors had failed to check them constantly by the steel reference tapes. This naturally affected the accuracy of the work.

Many traverse points (earthenware pipes) were removed by villagers at the beginning of the work. This caused much delay, but was stopped by action being taken against the owners of the land.

An area of 23,570 acres was covered by this work, 1,500 points being observed, including the points placed in four villages for the $\frac{1}{1250}$ work.

Detail Survey Section.

The work has been delayed by various causes—the difficult country which the survey has now entered, the large number of trained men taken away for the trigonometrical section, and the change from the old method to the new.

The old work was only controlled by second order triangulation, in which the points were sometimes as much as 15 miles apart. The delay over the Carpas base prevented a change from the old method to the new method (*i.e.*, control by fourth order triangulation) till the middle of November, 1912.

The work on the hills is very difficult, and chaining is invariably "stepped." It was estimated that the average plan would be finished in 23 working days, but in this part of the country the surveyors will not be able to reach this standard, as the owners of the lands and trees have to be registered in addition to the execution of the ordinary survey work.

During the year 61 plans have been surveyed on the scale of $\frac{1}{2500}$, and 14 villages on the scale of $\frac{1}{1250}$.

Headquarter Office.

Maps Published.—Before the 1st April, 1912, 101 plans on the scale of $\frac{1}{2500}$, 11 villages on the scale of $\frac{1}{1250}$, and the plan of Nicosia town were sent to England. These were published in 1913. In addition, 18 plans on the scale of $\frac{1}{2500}$, eight villages on the scale of $\frac{1}{1250}$, and the plan of Famagusta town were sent to Egypt and printed by the Egyptian Survey Department.

Cost.

Trigonometrical Section.—The cost was £992 6*s.* 4*d.* The proportional cost was :—

	Per cent.
Salaries and allowances of staff	61
Chainmen and labourers	20
Village representatives	2
Travelling expenses	3
Rent	1
Transport of instruments	5
Base-measurements	8
	100

Detail Survey Section.—The cost was £1,556 15*s.* 3*d.* The proportional cost was :—

	Per cent.
Salaries and allowances of staff	53
Chainmen and labourers	36
Village representatives	8
Travelling expenses	2
Rent	1
	100

Headquarters.—The cost was £1,989 8*s.* 2*d.* The proportional cost was :—

	Per cent.
Salaries and allowances of staff	49
Travelling expenses	4
Rent	1
Drawing materials and instruments ...	25
Furniture (including tents)	8
Reproduction of maps	13
	100

The total cost of the survey branch, as distinct from the land registration branch, was therefore £4,538 9*s.* 9*d.* The only revenue was £21 3*s.* from the sale of maps.

FIJI.

Governor	Sir BICKHAM ESCOTT, K.C.M.G.
Officer in Charge of the Trigonometrical Survey.	Mr. G. T. MCCAW.
Assistant	Mr. T. RIMMER.

The Island of Viti Levu.

The field work was finished in March, 1912 During the last year the computations have been taken up in England, and, before the officer in charge returned to the field, arrangements had been made to finish the computations partly in England and partly in Fiji. It has been decided that the topography of the northern coast shall be plotted at the Ordnance Survey, Southampton, from the plates of the photogrammetric survey.

At Suva the geodetic co-ordinates of the main stations and a few of the intersected points were computed, and the results were given to the Lands Department, which has already begun maps on the new system.

The Island of Vanua Levu.

Reconnaissance for a base and an extension figure was first begun in September, 1912, near Lambasa. It was difficult to find a base that was long enough, as the cultivated land is in narrow strips or small pockets, and there are four wide rivers which traverse the district.

At the end of a month a suitable base, 3½ miles long, was selected at Tatua, in the Lambasa district, and a reconnaissance was then made round the eastern half of the island. As far as possible, beacons were built during the reconnaissance, but at the beginning only principal stations were beaconed until it was clear that the scheme could be carried through, when any intersected points that lay near the road from one main station to another were also beaconed.

At the end of two months 13 main and 10 intersected points had been beaconed, while 13 more main and eight more intersected points had been selected, the triangulation chart covering some 1,600 square miles.

An attempt to beacon Mount Thurston in January, 1913, failed, owing to ignorant guides. Most of the faces are vertical walls of bare rock. Another attempt will be made in the next dry season.

Before 31st March, 1913, concrete pillars had been built as base terminals, and a preliminary chaining of the line had been made, in order to locate the numerous small creeks and ditches in the section which crosses a mangrove swamp.

General Comment.

Very satisfactory progress has been made.

HONG KONG.

Governor	...	Sir F. H. May, K.C.M.G.
Director of Public Works	...	Mr. W. Chatham, C.M.G., M.I.C.E.
Principal Land Surveyor	...	Mr. L. C. Rees.

Organization of the Survey Department.

The Land Survey office is a branch of the Public Works Department. Its principal function in the past has been the survey of small leased areas. The development of the Colony has necessitated an extension of its operations.

Land Surveys... ... ... { Principal Land Surveyor. / 8 European surveyors.

Computing and Drawing Office { 2 Chinese computers. / 3 Chinese clerks. / 4 Chinese tracers.

The Principal Land Surveyor, in addition to supervising the usual survey work, is the executive officer for all matters relating to Crown lands.

Present State of Topography.

Only one topographical sheet has been published, on the scale of $\frac{1}{84480}$.

The Work of the Past Year.

Triangulation.—One surveyor, during the winter months, continued the original scheme and observed from 28 new stations, using a 5-inch micrometer theodolite. The limit for polygon errors has been 6″; no check base has yet been measured.

Topography.—No work on topographical scales has been done.

Cadastral Work.—Progress has been made with the survey of the Colony in connection with land settlement. About 55 miles of traverse have been run, and all traverse stations have been permanently marked on the ground. Much detail has also been mapped, but, owing to lack of staff, it has been impossible to employ men on survey work apart from land settlement.

Some 117 acres of villages, residential plots, &c. were also surveyed, as well as 28 plots of land in Hongkong and Kowloon, covering 403,700 sq. feet, for sale by auction.

Cost.

The cost of the survey branch, excluding charges for lighting, heating, &c., which cannot be separated from the cost of the Public Works Department, amounted to roughly £5,450. The proportional cost was:—

	Per cent.
Salaries	80
Conveyance allowances	7
Wages for coolies	5
Land survey expenses (camp equipment, &c.)	2
Triangulation	4
Transport and travelling expenses... ...	1
Incidental expenses...	1
	100

JAMAICA.

Governor ... ... Colonel Sir W. H. Manning, K.C.M.G., C.B.

Surveyor General ... ... Mr. C. Liddell.

Organization of the Survey Department.

There is no recognised survey department, but any cadastral surveys that are necessary are made by the Crown Lands Department, consisting of the Surveyor General, 3 assistant surveyors, 1 accountant, 2 clerks, 1 copyist, 1 typist and 132 bailiffs and headmen.

Present State of Topography.

No topographical sheets have yet been published.

The Work of the Past Year.

No trigonometrical or topographical work has been done.

Cadastral Survey.—This work, which includes surveys of lands forfeited to, bought by or sold by the Crown, consists of closed traverses, the closing errors varying from 1 in 3,000 to 1 in 422. During the year 132 miles of traverse were run (94 in 1911–12), and reconnaissance was made for 80 miles.

There are large areas requiring boundary lines and road schemes before the land can be offered for sale.

Maps.—In addition to a large number of plans and tracings for official and public use, 2,500 pantagraph reductions for the 1-inch map have been made. A rough compilation of the whole island, except two parishes, on the 1-inch scale has been finished, but no money can be found for the reproduction of the map in 1913–14.

Cost.

It is impossible to extract figures for the survey branch alone. The total expenditure for the whole department was £3,421 0*s.* 8*d.* (estimated £4,211 4*s.* 1*d.*), and the total revenue was £4,963 14*s.* 0*d.*

MALAY STATES.

High Commissioner	... ...	Sir Arthur Young, K.C.M.G.
Surveyor General	... ...	Colonel H. M. Jackson, late R.E.
Deputy Surveyor General	...	Vacant (Major G. S. Knox, R.E., has been appointed).

Organization of the Survey Department.

Headquarters	Surveyor General. Deputy Surveyor General. 6 Superintendents. 5 Office Assistant Superintendents.
Field staff	1 Deputy Superintendent. 15 Assistant Superintendents. 56 European surveyors. 336 Native surveyors.
Drawing Office	1 Chief draughtsman. 1 Superintendent Litho Section. 1 Foreman printer. 1 Instrument repairer. 24 Natives.

F. M. S.

Showing Progress of Trigonometrical Work

Scale 1 Inch to 64 Miles

MILES 50 40 30 20 10 0 80 100 150 MILES

Preliminary Triangulation previous to 1912.

Primary do (with some Secondary) previous to 1912

do and Secondary Triangulation previous to 1912.

(1912 Beaconing for Primary Triangulation Kelantan and Upper Perak completed)

Primary Triangulation during 1912

NOTE

The Sheets of the $\frac{1}{1,000,000}$ Series are numbered from 1 to 4, each covering an area of 4 degrees of latitude by 4 degrees of longitude. Each "Degree" Sheet is distinguished by the number of the $\frac{1}{1,000,000}$ Sheet in which it falls and a descriptive letter in accordance with arrangement given below. Similarly each "Standard" Sheet is given the number of the "Degree" Sheet in which it falls and an additional descriptive number in accordance with arrangement given below. Thus the extreme North-Western "Degree" Sheet will be known as 1-A, while the extreme North-Western "Standard" Sheet will be $1\frac{A}{1}$

Degree Sheets

A	B	C	D
E	F	G	H
I	J	K	L
M	N	O	P

(1)

Standard Sheets

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

(A)

96° E. of Greenwich

G.S.G.S., 2690 a

War Office, Sept., 1913

Technical School ...	...	1 Surveyor Instructor. 1 Assistant Surveyor Instructor.
Colonial Survey Section ...		Captain T. N. Dunman, R.E. Lieut. D. A. Hutchison, R.E. 4 N.C.O.'s, R.E.

The work of the survey department comprises :—

(i) Revenue and land application surveys.
(ii) Triangulation and topography.
(iii) Levelling.
(iv) Tidal observations.
(v) Magnetic survey.

The European probationers are trained partly at headquarters and partly in the field. The Asiatic probationers are trained for one year in the technical school.

Present State of Topography.

Some 1,400 square miles have been mapped on the 1-inch scale and 640 square miles on the 2-inch scale (see **Diagram** VIII). Of this, 952 square miles were mapped in 1911 ; it is evident, therefore, that the topographical survey is only just in working order.

At the request of the Federated Malay States Government the Colonial Survey Section has been lent for three years from May, 1912. Considerable progress in the topographical survey may therefore be expected in the next three years.

The Work of the Past Year.

Trigonometrical Branch.

The retirement of Mr. A. E. Young, who had been intimately connected with the triangulation of the Federated Malay States since 1892, and in general charge of this branch since 1898, is a great loss to the department. He has been succeeded by Mr. V. A. Lowinger.

The work of this branch was rather limited in 1912 owing to lack of staff.

Triangulation.—The only triangulation done was a short connection between the Kedah-Perlis series and the Admiralty triangulation of 1910. This connection was necessary in order to fix points on the western sea section of the Anglo-Siamese boundary, as the old Admiralty charts had been found to be too inaccurate.

The principal series through Kelantan was beaconed for observations in 1913. **Diagram** VII shows the present state of triangulation.

Precise Levelling.—The precise levelling of the Peninsula was begun in July, 1912. By the end of the year, 157 miles had been levelled in both directions, and 88 bench marks had been established.

Precise Traverses.—The precise traverse and triangulation of the Pahang river was continued, and control traverses of the first order were run in Johore, Negri Sembilan and Selangor. The traverse of the main watershed which divides Selangor from Pahang was also begun ; this will control surveys for mining leases.

Altogether, 17,606 chains of precise traverse were measured, with an average closing error on the triangulation of 1 in 22,600. Theoretically, traverses measured with extreme care, with invar tapes, tension supports, &c., should agree with the trigonometrical distances to within 1 in 25,000 on favourable ground.

It has been found, however, that such traverses, measured along stretches of level railway in Johore—that is, under particularly favourable conditions— have a closing discrepancy of not less than 1 in 15,000.

It is also found that the traverse distances are invariably shorter than the trigonometrical distances.

It seems possible, therefore, that the triangulation may have acquired an error in scale during its slow progress down the Peninsula, nor could this be thought remarkable if the varied history of the progress is considered.

The proposed revision, to begin in 1914, of the main triangles, and the measurement of two long bases, one as far north and one as far south as possible, is, therefore, fully justified.

Miscellaneous.—Three members of the trigonometrical staff were employed on finishing the building of the permanent boundary marks on the Anglo-Siamese boundary.

The trigonometrical branch also helped the Colonial Survey Section considerably at the beginning of its topographical work by re-clearing hills and providing data in a suitable form.

Topographical Branch.

The progress of this branch was also restricted, through lack of trained European surveyors for supervision and examination, the absence on leave of the Assistant Superintendent, and sickness.

Some 478 square miles on the 1-inch scale were surveyed in very difficult country in Perak, among forest-clad hills 3,000 to 5,000 feet in height.

In addition four sheets, on which much of the work had been done by young surveyors in 1910, were thoroughly examined and revised where necessary before being sent for publication.

Colonial Survey Section.

To enable the section to gain the necessary local experience, it was decided to begin with the survey of a small area round Seremban on the scale of 2 inches to 1 mile. Some 21 sq. miles were surveyed in about six weeks.

The four topographers then began work on the quarter degree sheet $\frac{F}{8}$ of the Federated Malay States series, and 187 square miles were mapped in five months. This gives an average of 0·3 square mile a day, or 0·57 square mile a working day (8 hours).

The country was of average difficulty, consisting of undulating ground, partly covered with forest, partly planted with rubber, &c. When the topographers have learnt by experience to select only such detail as is essential on a 1-inch topographical map, the progress will be quicker. Two officers can supervise and generally superintend, as well as prepare auxiliary control points for, six to eight topographers; a request has accordingly been made for two more topographers.

F. M. S.

Showing Progress of Topographical Work

Scale 1 Inch to 64 Miles

MILES 50 40 30 20 10 0 50 100 150 MILES

REFERENCE

- *Previous to 1912 (Scale 2=1 Mile)*
- *During Do. Do.*
- *Previous to 1912 (Scale 1=1 Mile)*
- *During Do. Do.*
- *Previous to 1912 (Scale 1=2 Miles)*

NOTE

The Sheets of the $\frac{1}{1,000,000}$ Series are numbered from 1 to 4, each covering an area of 4 degrees of latitude by 4 degrees of longitude. Each "Degree" Sheet is distinguished by the number of the $\frac{1}{1,000,000}$ Sheet in which it falls and a descriptive letter in accordance with arrangement given below. Similarly each "Standard" Sheet is given the number of the "Degree" Sheet in which it falls and an additional descriptive number in accordance with arrangement given below. Thus the extreme North-Western "Degree" Sheet will be known as 1-A, while the extreme North-Western "Standard" Sheet will be 1 $\frac{4}{1}$

Degree Sheets

A	B	C	D
E	F	G	H
I	J	K	L
M	N	O	P

(1)

Standard Sheets

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

(A)

96° E. of Greenwich 100° 104° 108°

8° 4° 0°

G.S.G.S. 2690. b

War Office, Sept. 1913

Revenue Survey Branch.

The total area of surveys for agricultural grants, mining leases, native holdings, reserves, &c., was 264,952 acres (271,612 acres in 1911), or 414 square miles. The total chainage was 642,001 chains, or 8,025 miles.

As regards applications or requisitions not completed, the department is in about the same position as at the end of 1911.

Central Survey Office.

The fair drawing of the topographical series (quarter degree sheets) was begun, and the three first sheets were finished for photo-reduction. Various difficulties, chiefly climatic conditions, which affected paper and photographic processes, delayed the publication of these sheets during the year.

Other work consisted of the finishing of the fair map of the Anglo-Siamese boundary, outline maps on the ¼-inch scale of Perak, Selangor, Negri Sembilan and Pahang, the colonial survey section 2-inch map of Seremban, tracings for lithography of six sheets of a large-scale (1 chain = 1 inch) map of Kuala Lumpur town, a revised ¼-inch map of Pahang, and a revised ½-inch map of Perak. The outline plates of these two state maps were printed at the end of 1912 and the beginning of 1913.

Much miscellaneous work was also done for various Government departments, *e.g.*, medical, railway, geological, mining, forest, agriculture, &c.

The Photo-Litho section worked at the maps mentioned above, and also prepared and printed a large anti-malarial poster (six colours) in four languages.

Progress maps, a topographical map in three colours of Taiping, and miscellaneous Government orders were also printed during the year.

In all, 174 negatives were made, and 103,266 impressions were pulled, a very large increase on the output of the previous year.

A large lithographic machine, a plate-grinding machine, a larger paper guillotine and arc lamps were installed.

The instrument-repairing section proved very useful, and an additional European instrument repairer has been authorised for 1913.

The technical school turned out 37 probationers, of whom five were Malays, 27 natives of India or Ceylon, and five Chinese.

Cost.

Expenditure and Revenue.—Figures for the survey branch alone cannot be given. The total expenditure on revenue surveys was $794,175 (£92,650), of which $290,874 (£33,930) were recovered in revenue, *i.e.*, 37 per cent. of expenditure (41 per cent. in 1911).

Different Classes of Survey.—No figures for triangulation can be given.

Topographical Branch.—The average net cost of topography, *i.e.*, including all field expenses and salaries, but not supervision, examination or general superintendence, was $61 (£7 2*s.* 4*d.*) per square mile ($63 in 1911). The gross cost, excluding only purchase of instruments, was $85·98 (£10 0*s.* 7*d.*) per square mile ($87·32 in 1911).

A safe estimate can now be made of the cost of two classes of country, namely, $80 (£9 6*s.* 8*d.*) per square mile for difficult country (high forest-covered hills), and $50 (£5 16*s.* 8*d.*) per square mile for easy country (flat, with a few hills, partly forest and swamp, partly cultivated). These rates include everything except cost of equipment.

Colonial Survey Section.—The net cost, including only salaries and expenses of topographers, was $52 (£6 1*s.* 4*d.*) per square mile, and the gross cost, excluding only the cost of equipment, was $95 (£11 1*s.* 8*d.*) per square mile. It is too early as yet to say what the cost will be eventually.

Revenue Survey Branch.—The net cost of the field work was $0·64 (1*s.* 6*d.*) per chain, *i.e.*, about the same as last year.

TRINIDAD.

Governor... ... ... Sir G. R. LeHunte, G.C.M.G.
Engineer in charge of Surveys... Mr. E. R. Smart.

Organization of the Survey Department.

Staff ... ...
- Engineer in charge.
- 2 Assistants.
- 4 Draughtsmen.
- 1 Clerk and Draughtsman.

The survey office is a branch of the Crown Lands Department, and its chief work is to survey Crown lands for which application has been made, or oil concessions.

Present State of Topography.

No systematic topographical survey has been made, but Messrs. Stanford and Son have published a map in 11 sheets, on the scale of $\frac{1}{50000}$, showing concession boundaries and some detail.

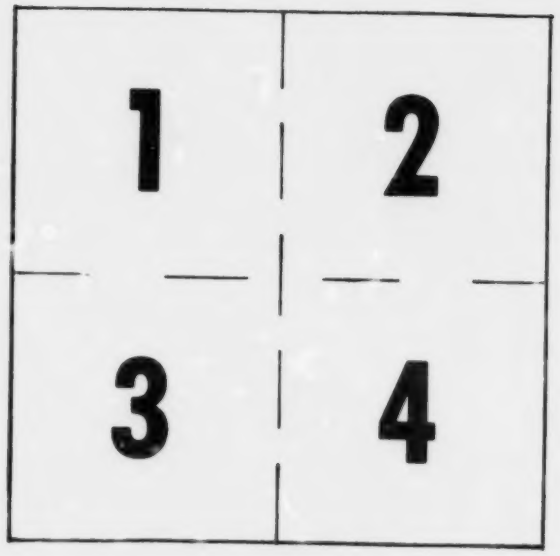
The Work of the Past Year.

No triangulation or topography has been done.

Cadastral Surveys.—During the year 279 survey orders were issued for areas varying in size from 1 to 50 acres. An oil concession of 800 acres was also surveyed, and an estate of 1,800 acres.

The ward maps of Cedros have been improved by the re-survey of main roads and chief boundary lines.

Maps on this order too large to be entirely included in one exposure are filmed clockwise beginning in the upper left hand corner, left to right and top to bottom as many frames as required. The following diagrams illustrate the method.



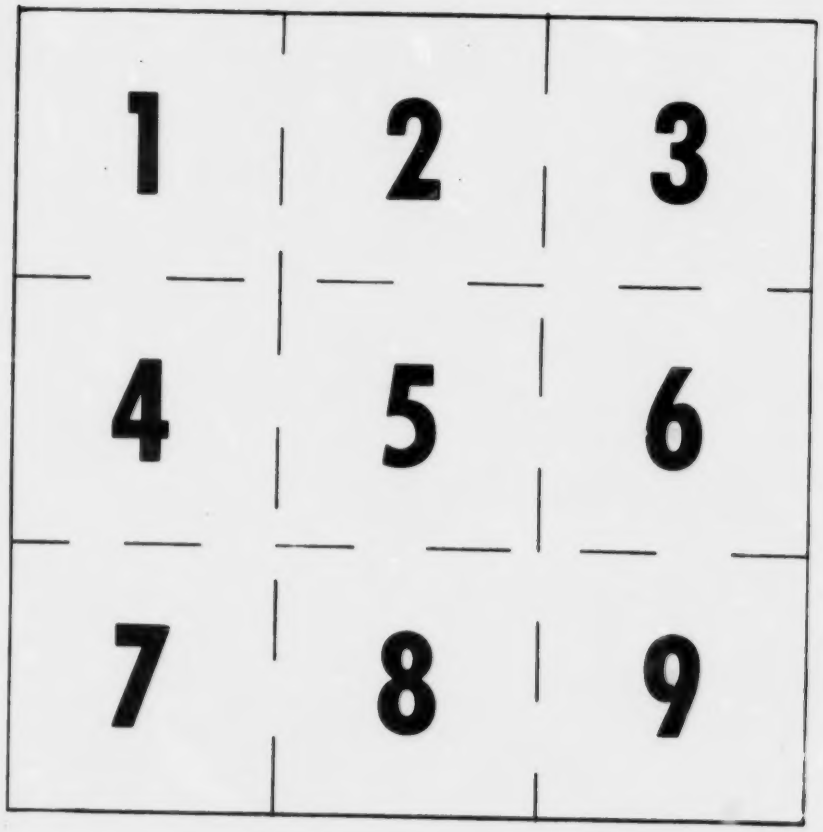


Diagram IX.

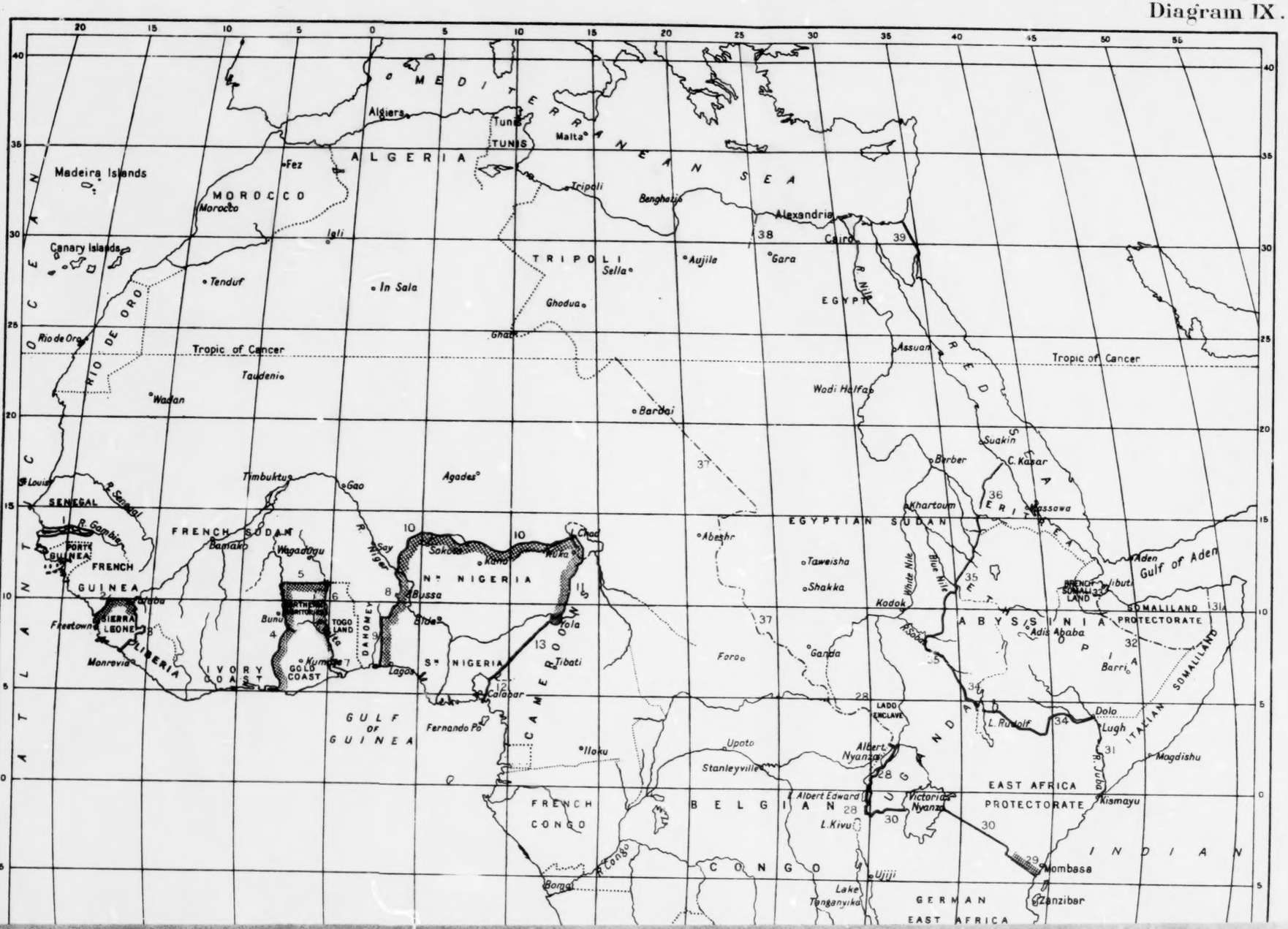

MEDITERRANEAN SEA
Algiers
Tunis
TUNIS
Malta
ALGERIA
Madeira Islands
Fez
MOROCCO
Morocco
Tripoli
Benghazi
Alexandria
Cairo
Canary Islands
Igli
TRIPOLI
Sella
Aujila
Gara
Tenduf
In Sala
Ghodua
Ghadames
EGYPT
R. Nile
Rio de Oro
RIO DE ORO
Tropic of Cancer
Taudeni
Wadan
Assuan
Wadi Halfa
Barbai
Suakin
Berber
C. Kasar
Timbuktu
Gao
Agades
Khartoum
Massawa
ERITREA
EGYPTIAN SUDAN
St Louis
R. Senegal
SENEGAL
R. Gambia
PORTUGUESE GUINEA
FRENCH GUINEA
FRENCH SUDAN
Bamako
Wagadugu
R. Niger
Say
Sokoto
Kano
Nr NIGERIA
Chad
Nuka
Abeshr
Taweisha
Shakka
White Nile
Blue Nile
Kodok
Aden
Gulf of Aden
FRENCH SOMALI LAND
Djibuti
SOMALILAND PROTECTORATE
ABYSSINIA
Adis Ababa
Bussa
Ilorin
Bunu
Freetown
SIERRA LEONE
LIBERIA
Monrovia
IVORY COAST
GOLD COAST
Kumasi
TOGO LAND
DAHOMEY
Lagos
Sr NIGERIA
Tibati
Foroa
Ganda
Barri
ATLANTIC OCEAN
GULF OF GUINEA
Fernando Po
Calabar
CAMEROONS
LADO ENCLAVE
L. Rudolf
Dolo
Lugh
ITALIAN SOMALILAND
Magdishu
Upoto
Albert Nyanza
Stanleyville
Iloku
EAST AFRICA PROTECTORATE
L. Albert Edward
Victoria Nyanza
Kismayu
FRENCH CONGO
BELGIAN CONGO
L. Kivu
Ujiji
Mombasa
Lake Tanganyika
Zanzibar
GERMAN EAST AFRICA
Bomu
Congo
INDIAN OCEAN

DIAGRAM
TO ILLUSTRATE
THE
PROGRESS OF THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA

Scale of the Diagram
26,812,000 or 1 inch to 450 Miles
Miles 100 0 100 300 500 700 900 Miles

British Boundaries marked & ratified
Do. Do. surveyed
Do. Do. not yet surveyed

G.S.G.S. Nº 2226 (a)

War Office. August 1906.
Revised Aug. 1913.

Maps.—Twelve sectional plans on the scale of $\frac{1}{50000}$, each 42 inches by 26 inches, have been published during the year. It was expected that a general plan of Trinidad, on the scale of $\frac{1}{150000}$, coloured to show alienated lands, forest reserves and oil concessions, would be published by the end of April, 1913. The material is taken mainly from the ward maps, but is controlled by the trigonometrical survey.

Cost.

The total cost of the department was £4,021 8*s.* 5*d.* (£4,571 12*s.* 4*d.* in 1911-12). The proportional cost was :—

	Per cent.
Salaries and allowances	47
Expenses of surveys	47
Travelling expenses	6
	100

V.

WORK OF BOUNDARY COMMISSIONS DURING THE YEAR.

Diagram IX shows the state of progress of the delimitation of British frontiers in Africa.

During the past year five Boundary Commissions were at work in Africa—two on first surveys, one on demarcation, and two on small rectifications.

First Surveys.

1. The Anglo-Belgian (Rhodesia-Congo) Boundary Commission.

This Commission was divided into two groups towards the end of 1911, the first group working on the Rhodesia-Katanga (Zambesi-Congo Watershed) boundary, and the second group on the survey of the meridian which forms the boundary south of Lake Bangweolo, together with a large area on either side of the meridian.

The Commission did not stop work during the rainy season of 1911-12, but remained in the field till the beginning of the rainy season of 1912-13, when the whole Commission returned to England for the recess.

1st Group.

The British members were :—

Commissioner	Major R A. Gillam, R.E.
Assistant Commissioners ...	Captain E. A. Steel, R.A.,
	Lieutenant S. Gore-Browne, R.F.A.
Plane-tablers	Four Non-Commissioned Officers, R.E.

The watershed, which had been described as "bush" country, was found to be covered with a thick forest of trees which averaged 50 feet in height.

There were very few prominent features, and, in order to maintain triangulation, large towers had to be built (*see* Plates II and III). This naturally delayed progress and, by the end of 1912, it was realised that the 24th meridian could not be reached by May, 1913, that is, in time to give the Anglo-Portuguese Commissioners a rigid determination of longitude for the starting point of their work. When the rains prevented further work in the field, triangulation had been carried as far as 26° 15′ E., covering an area of some 6,300 square miles from the geodetic base. In addition to this some 1,450 square miles had been topographically surveyed.

In November, 1912, Major Gillam's health broke down, and he was not well enough to return with the Commission in March, 1913.

2nd Group.

The British members were :—

Assistant Commissioners ... { Captain R. WALKER, R.E.
Lieutenant O. E. WYNNE, R.E.

Plane-tablers ... ... Three Non-Commissioned Officers, R.E.

The country, though difficult, was not so troublesome as the watershed, and excellent progress was made. Before the rains broke, the longitude of Panta had been determined by triangulation from the geodetic base, and an area of some 5,800 square miles had been topographically surveyed. This group also brought to England an excellent topographical map, on the scale of $\frac{1}{250000}$, which had been made by Mr. H. Croad, an official of the British South Africa Company, in his spare time.

The map, which covered an area of some 11,000 square miles in the Serenje district, was based on a framework of triangulation, certain points of which were common to the boundary triangulation. The discrepancies in the lengths of sides and the heights above sea level were so small as to be negligible, and the map thus forms a valuable addition to the topography of Northern Rhodesia.

2. The Anglo-Belgian (Uganda-Congo) Boundary Commission.

This was a small Commission to survey the region embracing the northern limit of the so-called "Mahagi Strip," a distance of some 40 miles between the north-west shore of Lake Albert and the junction of the Sudan, Uganda, and Congo boundaries.

The British members were :—

Commissioner ... ... Captain A. M. COODE, R.E.
Escort Officer ... ... Captain W. T. BROOKS, K.A.R.

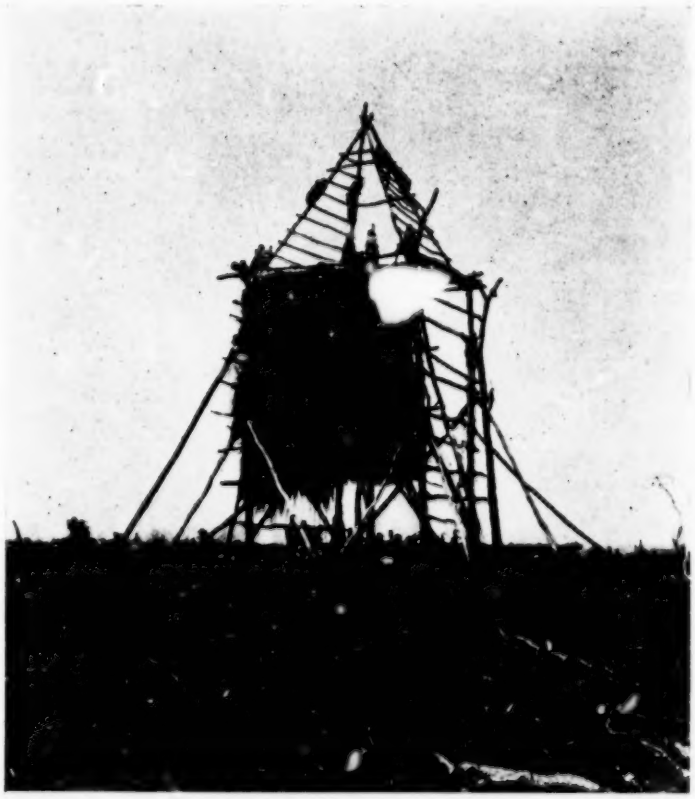
Work was begun near Mahagi in December, 1912, and, by the end of March, 1913, the triangulation was nearly finished. The points on the lake shore were connected across the lake with the Uganda triangulation, and the western end of the southern limit of the "Mahagi" Strip was also connected with the triangulation.

ANGLO-BELGIAN BOUNDARY COMMISSION

(RHODESIA-KATANGA SECTION).

TRIANGULATION DIFFICULTIES ON THE CONGO-ZAMBESI WATERSHED.

COMMUNICATION BY HELIOGRAPH (BEACON IN BACKGROUND).

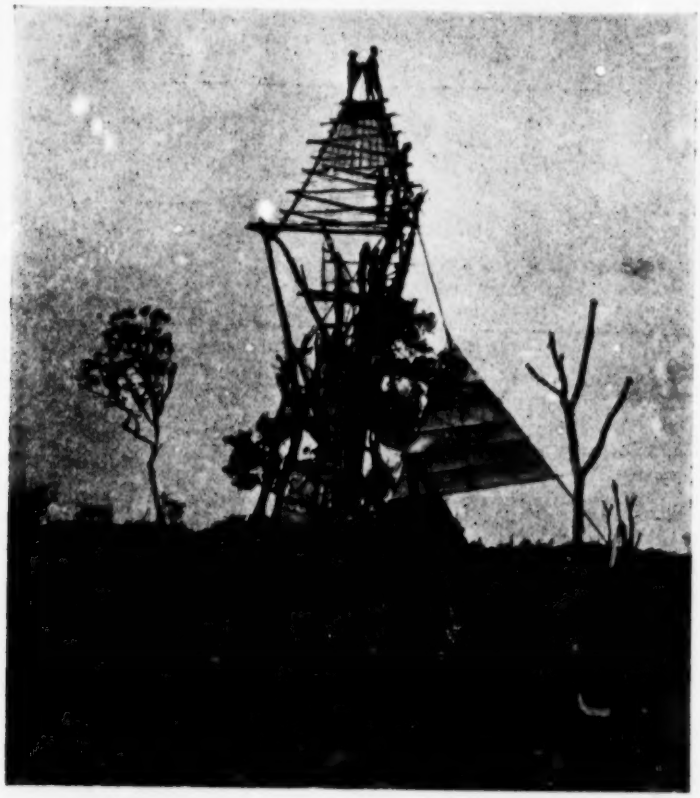


A 50-FT. BEACON BEING BUILT.

ANGLO-BELGIAN BOUNDARY COMMISSION

(RHODESIA-KATANGA SECTION).

TRIANGULATION DIFFICULTIES ON THE CONGO-ZAMBESI WATERSHED.



THE CALICO SCREENS OF A 66-FT. BEACON BEING HAULED INTO POSITION WHEN OBSERVING IS FINISHED.

A TREE BEACON.

Demarcation Commission.

In October, 1912, an Anglo-German Commission assembled on the Yola-Cross River frontier in Southern Nigeria, to beacon the boundary surveyed in 1907–09.

The British members were :—

Commissioner	Captain W. V. Nugent, R.A
Assistant Commissioner	Lieutenant W. F. R. Kyngdon, R.A.
Plane-tablers	Two Non-Commissioned Officers, R.E.

By the end of March, 1913, the frontier had been beaconed, and large additions to the topographical map had also been made.

Rectification Commissions.

1. Early in 1912 Captain F. N. Le Mesurier, a District Commissioner in Sierra Leone, surveyed, with a local French official, the rivers Meli and Moa, which had been adopted, towards the end of 1911, as a natural frontier between Sierra Leone and French Guinea, in place of the 13th meridian west of Paris.

2. The convention between Great Britain and Liberia, signed at Monrovia on January 21st, 1911, necessitated a further survey of the Anglo-Liberian boundary between the rivers Moa and Mauwa. Major E. L. Cowie and Captain J. G. V. Hart, both of the West India Regiment, were ordered to meet Liberian Commissioners in November, 1911, and to delimit the tribal boundaries which form this section of the frontier.

About six miles of boundary were beaconed when the action of the Liberian Commissioners made it impossible to continue the work.

The Commission re-assembled in February, 1913, the British members being the same, but the Liberian Commissioners had not been prevailed upon to do any delimitation by the end of March.

VI.

TABLE SHOWING THE PROGRESS MADE IN THE DELIMITATION OF BRITISH FRONTIERS IN AFRICA.

Red Nos. on Map.	Name of Boundary.	Length.	Treaty concerned and Date.	Commissioners.	Dates.				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
1	Anglo-French (Gambia)	Miles 125	Aug. 10th, 1889	British :— Capt. A. H. Kenney, R.E. French :— Capt. Pineau. M. Lecomte, Civil Administrator.	Nov., 1890, to May, 1891	May 1891	June 9th, 1891.	—	—
1	" "	"	" "	British :— Mr. H. Reeve. Mr. Ozanne. French :— M. Fargue. Lieut. de Jussien. M. Robert (Interpreter).	1895-6.	—	—	—	—
1	" "	"	" "	British :— Mr. H. Reeve. Lieut. A. H. Tyler, R.E.	1898-9.	—	—	—	—
1	" "	"	April 8th, 1904	British :— Major Cowie, W.I.R. Mr. B. B. de Tscharner.	1905-6.	—	—	—	—
2	Anglo-French (Sierra Leone—French Guinea).	260	Aug. 10th, 1889, Jan. 21st, 1895.	British :— Capt. A. H. Kenney, R.E. French :— M. Lamadon, Governor of the French Colony of Les Rivières-du-Sud.	Dec., 1891, to April, 1892.	—	—	—	From the Coast to Tembikunda.
2	" "	"	" "	British :— Lieut.-Col. J. K. Trotter, R.A. Capt. A. H. Tyler, R.E. French :— Capt. Passaga. Lieut. Cayrade. Lieut. Millot.	Dec., 1895, to May, 1896.	1895, 1896.	April 9th and 30th, 1896.	June 14th and 16th, 1898.	From the Coast to Tembikunda.

2	Anglo - French (Sierra Leone—French Guinea).	8	Aug. 10th, 1889, Jan. 21st, 1895.	Local Commission :— British :— Lieut. J. P. Mackesy, R.E. French :— Capt. Gaden.	Jan., 1899	—	—	—	Tembikunda to 13° W. of Paris.
2	"	"	" "	Local Commission :— British :— Mr. Birch. French :— M. Lescure.	1900 and Jan. 15th, 1903.	1903.	Mar. 12th, 1903.	Exchange of notes, Mar. 22nd and April 5th, 1904.	" "
2(*a*)	" "	"	Exchange of Notes, 6th July, 1911.	Local Commission to rectify part of boundary :— British :— Capt. le Mesurier. French :— Capt. Antony Cottes.	1911	1911.	Nov. 10th, 1911.	—	Handing over country between the Meli and Moa rivers.
2(*a*)	" "	"	" "	Local Commission to identify new boundary :— British :— Capt. F. N. le Mesurier. French :— Capt. M. P. Schwartz.	—	1912.	July 1st, 1912.	—	Tembikunda to junction of the Moa and Dandogbia rivers.
3	Anglo-Liberian (Sierra Leone—Liberia).	195	Nov. 11th, 1885	British :— Capt. H. D. Pearson, R.E. Lieut. E. W. Cox, R.E. Liberian :— Mr. J. McCarthy.	Jan., 1903, to July, 1903.	1903.	June 25th, 1903.	Jan. 21st, 1911.	
3	" "	20	21st January, 1911 ..	Local Commission to delimit new part of boundary :— British :— Major E. L. Cowie, W. I. R. Capt. J. G. V. Hart, W. I. R. Liberian :— Capt. Croll.	1912	1912.	—	—	From junction of the Moa and Dandogbia rivers to junction of the Morro and Mano rivers.
4	Anglo - French (Gold Coast—Ivory Coast).	450	July 12th, 1893	British :— Major A. E. G. Watherston, R.E. Capt. Soden, R. Fusrs. Capt. H. B. Des Voeux, R.E. French :— M. Delafosse. Capt. Bouvet. Lieut. Laforgue.	May, 1902, to Feb., 1903.	1902 to 1903.	Feb. 1st, 1903.	May 11th and 15th, 1905.	—
	Anglo - French (Gold Coast, Northern Territories—French Sudan).	195	Convention, June 14th, 1898.	British :— Major A. E. G. Watherston, R.E. Lieut. F. B. Henderson, R.N. French :— M. P. Peltier. M. A. Chérier.	1900.	—	Aug. 16th, 1901.	—	—

Red Nos. on Map.	Name of Boundary.	Length.	Treaty concerned and Date.	Commissioners.	Dates.				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
5	Anglo-French (Gold Coast, Northern Territories—French Sudan).	Miles 195	Agreement, Mar. 18th and April 26th, 1904.	British :— Capt. J. O'Kinealy. French :— Lieut. F. Verlaque.	—	1904.	Oct. 19th, 1904.	May 24th and July 19th, 1906.	—
6	Anglo-German (Gold Coast, Northern Territories—Togo).	165	Convention, Nov. 14th, 1899.	British :— Capt. W. J. Johnston, R.E. Lieut. J. F. Turner, R.E. German :— Count Zech. Baron von Seefried.	Dec., 1901, to Sept., 1902.	1902.	July 21st, 1902.	—	Between Mamprussi and Chakosi.
6	" "	"	" "	British :— Capt. H. B. Des Voeux, R.E. German :— Baron von Seefried.	—	Sept., 1904, to Dec. 15th, 1905.	—	June 25th, 1904.	North of 9th parallel only.
7	Anglo-German (Gold Coast—Togoland).	125	Convention, July 1st, 1890.	British :— Lieut. A. E. Coningham, R.E. German :— Baron von Seefried.	May, 1904, to Oct., 1904.	1904.	Oct. 11th, 1904.	—	From Coast to mouth of river Dayi, except between 6° 10′ and 6° 20′.
8	Anglo-French (Lagos—Dahomey).	235	June 14th, 1898	British :— Major J. I. Lang, C.M.G., R.E. French :— Commdt. Touteé.	1900.	1900 Trees blazed and some cairns built.	Dec. 22nd, 1900, and Jan., 1905.	Oct. 19th, 1906.	From 9° N. Lat. to Niger.
9	" "	200	August 10th, 1889, Jul. 12th, 1893.	British :— Mr. F. C. Fuller. Mr. A. G. Fowler. Dr. Hay. French :— Capt. J. Plé. Lieut. Brisson.	1895-6.	1895-96 Trees blazed and some cairns built.	Oct 12th, 1896, Art. II. June 14th, 1898.	Oct. 19th, 1906.	From the Coast to 9° N. Lat. Treaty Series No. 15, 1899. } See one in change of notes.
9	" "	"	" "	British :— Capt. Anderson. French :— M. Perreur	1900.	—	Jan. 20th, 1900.	—	Examination of frontier from confluence of river Iguidu and river Igiawun to *road 200* metres north of Ikotru.

9	Anglo-French (Lagos-Dahomey).	200	August 10th, 1889, July 12th, 1893.	Re-Survey Commission :— British :— Major F. G. Guggisberg, C.M.G., R.E. French :— Commandant Fourn.	—	1912.	July 20th, 1912.	—	—
10	Anglo-French (Niger—Chad).	860	June 14th, 1898, April 8th, 1904.	British :— Lieut.-Col. G. S. McD. Elliott R.E. Capt. C. H. Foulkes, R.E. Capt. G. R. Frith, R.E. Lieut. G. F. Evans, R.E. French :— Capt. Moll. Capt. Carpinetty. Capt. Tilho. Capt. Jaques. M. Hummel.	Nov., 1902, Jan., 1904.	—	April 9th, 1906, May 29th, 1906.	—	—
10	"	"	May 29th, 1906	British :— Major R. P. O'Shee, R.E. Major C. B. Simonds, R.A. Lieut. J. G. Hearson, R.E. French :— Capt. Tilho. Lieut. de Vaisseau Andoin. Lieut. Vignon.	1906, 1907.	1907, 1908.	Feb. 25th, 1908, and Feb. 19th, 1910.	Exchange of Notes, May 17th, 1911, and July 1st, 1911.	Treaty Series No. 1, 1912.
11	Anglo-German (Yola—Chad).	350	Convention, Nov. 15th, 1893. Preliminary Agreement, Dec. 2nd, 1902.	British :— Lieut.-Col. L. Jackson, R.E. Capt. G. F. A. Whitlock, R.E. Lieut. L. C. Jackson, R.E. Lieut. L. C. A. de B. Doucet, R.E. German :— Hptmann Glauning. Oblt. Marquardsen. Leut. Stephani. Leut. Schultze.	Aug. 10th, 1905, Feb., 1903, to Feb., 1904 and 1905.	Pillars erected on shore of Lake Chad.	Feb. 24th, 1904, and Mar. 19th, 1906.	July 16th, 1906.	Treaty Series, No. 17, 1906.
11	" "	40	" "	Local Commissions to mark Boundary :— British :— Mr. Hans Fischer. German :— Leut. von Stephani.	—	1906 to 1907.	Feb. 12th, 1907.	Mar. 5th, 1909.	From Gorege to Lake Chad. Treaty Series, No. 17, 1909.
11	"	81	" "	British :— Capt. Vicars Boyle. German :— Capt. von Stephani.	—	1907.	Mar. 11th, 1907.	Mar. 5th 1909.	From Uba, on Yedseram River, to River Benue.
12	Anglo-German (Cross River, or Southern Nigeria—Cameroons).	140	Conventions, April 29th and May 7th, 1885. July 27th and Aug. 2nd, 1886, July 1st, 1890, April 14th, 1893, Nov. 15th, 1893.	British :— Capt. C. F. Close, R.E. Capt. E. P. S. Roupell. German :— Leut. von Besser.	1895.	—	—	—	Cross River to the sea.

Red Nos. on Map.	Name of Boundary.	Length.	Treaty concerned and Date.	Commissioners.	Dates.				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally Approved.	
		Miles.							
12	Anglo-German (Cross River or Southern Nigeria—Cameroons).	140	Conventions, April 29th and May 7th, 1885, July 27th and Aug. 2nd, 1886. July 1st, 1890, April 14th, 1893. Nov. 15th, 1893.	British :— Capt. A. J. Woodroffe, R.E. Lieut. J. G. Hearson, R.E. German :— Hptmann Herrmann. Leut. von Roebel.	Dec. 1905, May, 1906.	1906.	1906.	—	Cross River to the sea.
13	Anglo-German (Cross River Rapids—Yola Arc).	285	Nov. 15th, 1893	British :— Lieut-Col. G. F. A. Whitlock, R.E. Capt. H. T. G. Moore, R.E. Lieut. W. V. Nugent, R.A. 2nd Lieut. W. D. Downes, Royal Sussex Regiment. German :— Major Haering. Oblt. von Stephani. Oblt. Cuno. Oblt. Rothe.	Aug., 1907, to May, 1909.	—	April 16th, 1909.	—	—
13	" "	"	" "	Commission to mark boundary :— British :— Captain W. V. Nugent, R.A. Lieut. W. F. R. Kyngdon, R.A. German :— Oberleutnant Detzner.	—	1912 and 1913.	April 12th, 1913.	—	—
14	Anglo-Portuguese (Barotseland—Angola).	710	Convention, July 11th, 1891, and Arbitration award, May 30th, 1905.	British :— Major H. W. Gordon, R.E. Captain A. G. Turner, R.E. Lieut. W. D. Downes, Royal Sussex Regiment. Portuguese :— Lieut. Commander C. L. Gago Coutinho. Lieut. F. T. V. da Rocha. Lieut. A. S. Friere Cabral. Lieut. J. Candido da Costa Marques.	1913.	—	—	—	—
15	Walfish Bay	75	July 1st, 1890, and Proclamation of annexation, Mar. 12th, 1878.	——	—		—	—	Not yet delimited.

16	Anglo-German (Bechuanaland — German South-West Africa).	1113	July 1st, 1890, Art. III. (A.G.), Dec. 30th, 1886, Art. I. (G.P.); June 11th, 1891, Art. IV. (A.P.).	British :— Major H. D. Laffan, R.E. German :— Oblt. Doering. Leut. Wettstein.	Nov., 1898, to Oct., 1903.	1898 to 1903. From Orange River to Reitfontein.	—	—	Part only of boundary delimited.
16	Anglo - German (Cape Colony — German South-West Africa).		July 1st., 1890, Art. III.	——	—	—	—	—	Not yet delimited.
17	Anglo-Portuguese (Amatongalani — Portuguese East Africa).	30	June 11th, 1891, Art. III.	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	Aug., 1896, to Dec., 1896.	—	—	—	—
17	" "	"	" " "	British :— Mr. W. Bosman. Portuguese :— Capt. Nunes da Silva.	—	Aug. and Oct., 1897.	Oct. 2nd, 1897.	Dec. 29th, 1898/Jan. 25th, 1899.	—
18	Swaziland — Portuguese East Africa	65	Conference, April to June, 1907.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D. N. de C. Noronha.	1888, 1894, and 1897.	April, 1907	—	—	Portuguese and Boer Commission.
19	Transvaal — Portuguese East Africa.	255	July 29th, 1869. Convention of London, Feb. 27th, 1884.	British :— Major J. G. Baldwin, R.A. Mr. W. H. Gilfillan. Mr. J. Smuts. Portuguese :— Major A. Freire D'Andrade. Lieut. A. de S. Freire Cabral. Lieut. D.N. de C. Noronha.	1887, 1890, and 1894.	1887, 1890, 1894.	—	—	Portuguese and Boer Commission.
19	" "	"	" " "	Transvaal :— Mr. H. E. Schoch. Portuguese : Lieut. A. G. d'Azevedo Franco.	—	1906	Sept. 12th, 1906.	—	Demarcation from source of Matimgatinga river and beacon on bank of Incomati river.

Red Nos. on Map.	Name of Boundary.	Length.	Treaty concerned and Date.	Commissioners.	Dates.				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
20	Anglo-Portuguese (Southern Rhodesia—Portuguese East Africa, Limpopo River to Sabi River).	Miles 115	June 11th, 1891	Local Commission :— British:— Mr. W. J. Atherstone Portuguese :— José A. Serrano.	Dec. 1902, to July, 1903.	—	Dec. 21st, 1903/July 19th, 1904.	June 3rd, 1907.	In one exchange of notes.
	Anglo-Portuguese (Southern Rhodesia—Portuguese East Africa, 18° 30′ S. to Sabi River); also called Mazoe, or Manica, Boundary.	235	June 11th, 1891, and Arbitral award, Jan. 30th, 1897.	British :— Major J. J. Leverson, R.E. Capt. S. C. N. Grant, R.E. Lieut. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade. Lieut. E. Salta de Susa. Capt. J. M. Severano. M. R. Machado de Faria Maia.	1892.	—	—	June 3rd, 1907.	
21	"	"		British :— Capt. C. S. Wilson, R.E. Portuguese :— Capt. A. Freire D'Andrade.	—	1898, 1899.	June 5th and 28th, 1898, and Dec. 14th and 15th, 1898.	—	18° 30′ S. to junction of Sabi and Lundi rivers.
22	Anglo-Portuguese (Southern Rhodesia—Portuguese East Africa, Mazoe River to 18° 30′ S.); also called Barue Boundary.	145	June 11th, 1891	British :— Lieut.-Col. J. J. Leverson, R.E. Capt. A. E. G. Watherston, R.E. Lieut. C. R. Brown, R.E. Portuguese :— Capt. Garcia Rosado.	1898.	1905	Dec. 28th, 1898.	Mar. and April, 1902, Jan. and April, 1904, July 22nd, 1912, and Aug. 9th 1912.	Exchange of notes. " "
23	Anglo-Portuguese (Southern Rhodesia—Portuguese East Africa, South of the Zambesi).	215	" "	Local Commission :— British :— Mr. Sawerthal. Portuguese :— Lieut. Durao	1903-4.	—	—	—	Provisional survey.

23	Anglo-Portuguese (Southern Rhodesia—Portuguese East Africa South of the Zambesi).	215	June 11th, 1891	Re-Survey Commission :— British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox, R.E. Portuguese :— Lieut. C. L. Gago Coutinho. Lieut. F. T. V. da Rocha.	April 1905, to Oct., 1905.	1905.	Oct. 4th, 1905.	Exchange of Notes 21st Oct., 1911, 20th Nov., 1911.	–
23	„ „	47	.. ..	Local Commission, to take over part of boundary :— British :— Mr. E. R. Morkell. Capt. J. Tait, B.S.A. Police. Portuguese :— Luiz Lopes de Conceicas, Junior. Jayme Lino.	—	—	Nov. 13th, 1910.	—	Line from Mount Gungwa to Mount Chera taken over.
24	Anglo-Portuguese (North-Eastern Rhodesia—Portuguese East Africa, North of the Zambesi).	260	June 11th, 1891	British :— Major O'Shee, R.E. Capt. A. N. Campbell, R.A. Lieut. L. C. A. de B. Doucet, R.E. Lieut. E. W. Cox. Portuguese :— Lieut. C. L. Gago Coutinho. Lieut. Fradique.	June, 1904, to Nov., 1904.	1904	Nov. 21st, 1904.	Exchange of Notes 21st Oct., 1911, 20th Nov., 1911.	–
25	Anglo-Portuguese (British Central Africa, now Nyasaland, Protectorate—Portuguese East Africa).	660	. ..	British :— Mr. J. F. Cunningham. Mr. T. I. Binnie, Surveyor Portuguese :— Capt. Ferraz. Conde. Du Pont. Capt. Branco.	July to Nov., 1899. Oct. to Dec., 1900.	1899–1900.	Dec. 8th, 1900.	*Sept. 15th, 1906.	Section from River Ruo to Lake Chiuta Provisional Boundary Commission.
25	„ ..			British :— Mr. A. James Swann. Mr. Thomas I. Binnie, Surveyor.					
25	„ „	91	„ „	Local Commission :— British :— Mr. A. J. Swann. Mr. T. F. Firr, Surveyor. Portuguese :— 2nd Lieut. Antonio de Brito.	—	1907.	—	—	To make some alterations to previous line. Beaconed from B. P. 38 to Mt. Kapiriuta.
25	„ „	—	June 11th, 1891	Local Commission :— British :— Mr. T. I. Binnie. Portuguese :— Ernesto Tavares D'Almeido Carvalho.	April–May, 1908.	—	May 22nd, 1908.	Exchange of Notes, 6th and 30th Nov., 1911.	Ruo and Shire Rivers.

* Provisional confirmation of recommendations of Boundary Commissioners 1899 and 1900 (Procés Verbal. December 8th, 1900).

Red Nos. on Map.	Name of Boundary.	Length.	Treaty concerned and Date.	Commissioners.	Dates.				Remarks.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
26	Anglo-German (Nyasa-Tanganyika).	Miles 225	July 1st, 1890	British :— Capt. C. F. Close, R.E. Capt. F. R. F. Boileau, R.E. Capt. Chichester. Lieut. Scratchley. German :— Hptmann Herrmann. Leut. Glauning. Dr. Kohlschütter.	1899.	1898.	Nov. 11th, 1898.	Feb. 23rd, 1901.	—
27	Anglo-Belgian (Northern Rhodesia—Congo Free State, now Belgian Congo).	1,200	May 12th, 1894 ..	British :— Major R. A. Gillam, R.E. Capt. R. Walker, R.E. Capt. E. A. Steel, R.A. Lieut. S. Gore-Brown, R.F.A. Lieut. O. E. Wynne, R.E. Belgian :— Major Begraud. Capt. Weber. Lieut. Lepoivre. „ Gendarme. „ van Bleyenberg. „ Wuidart. „ Donner. „ Ermeus.	1911-12.	1912	-	-	—
27	„	„	„ „ „	British :— Rhodesia-Katanga Section :— Capt. E. A. Steel, R.A. Lieut. S. Gore-Brown, R.F.A. „ E. M. W. Sealy, R.E.	1913	—	—	—	—
				Mweru-Tanganyika Section :— Capt. R. Walker, R.E. Lieut. O. E. Wynne, R.E.	1913	—	—	—	—

26	Anglo-Belgian (Uganda—Congo Free State, now Belgian Congo).	800	May 12th, 1894, and May 9th, 1906.	British :— Lieut.-Col. R. G. T. Bright, C.M.G., Rifle Brigade. Capt. E. M. Jack, R.E. Lieut. Hon. F. R. D. Prittie, Rifle Brigade. Belgian :— Commandant E. Mercier, 2nd Regiment des Guides. Commandant J. Bastien, 2nd Regiment des Grenadiers. Commandant Stockhausen. Lieut. Weber. Lieut. Mauray.	Jan., 1907 to April, 1908.	—	..	—	-
28	„ „ „	36	—	British :— Major E. M. Jack, R.E. Capt. Hon. F. R. D. Prittie, Rifle Bgde. Belgian :— Capt. Commandant J. Bastien. Capt. Maury Lieut. Weber. Lieut. Wuidart.	—	1911.	May 4th, 1911.	—	From Mount Sabinio to Mount Nkabwa.
28	„ „ „ Mahagi Strip.	40	—	British :— Lieut. A. M. Coode, R.E. Belgian :— Lieut. Jadot.	1913.	—	May 14th, 1913.	—	—
29	Anglo-German (British East Africa—German East Africa, Indian Ocean to Lake Jipe).	118	July 1st, 1890	British :— Consul Smith, R.N. Lieut. G. E. Smith, R.E. German :— Dr. Carl Peters.	1892.	—	July 25th, 1893.	—	Preliminary Survey.
29	„ „ „	„	July 25th, 1893	Local Commission :— British :— Mr. A. Hardinge. German :— Oberst Liebert.	1897.	1900.	Jan. 2dth, Feb. 14th, and April 25th, 1900.	—	Not beaconed throughout its entire length.
30	Anglo-German (British East Africa—German East Africa, Lake Jipe to Victoria Nyanza).	350	Treaty, July 1st, 1890 Convention, July 25th, 1893.	British :— Lieut.-Col. G. E. Smith, R.E. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	Apr., 1904, to Jan., 1906.	1904 to 1906.	July 18th, 1906.	—	-

Red Nos. on Map.	Name of Boundary.	Length.	Treaty concerned and Date.	Commissioners.	Dates.				REMARKS.
					Delimitation Survey.	Marked on Ground.	Protocol signed.	Finally approved.	
		Miles							
30	Anglo-German (Uganda—German East Africa).	150	July 1st, 1890	British :— Col. Delme Radcliffe. Major R. G. T. Bright, Rifle Bde. Lieut. T. T. Behrens, R.E. German :— Hptmann Schlobach. Oblt. W. Schwartz. Oblt. M. Weiss.	July, 1902, to Apr., 1904.	1904.	July 18th, 1906.	–	-
30	" "	65	—	British :— Major E. M. Jack, R.E. Capt. Hon. F. R. D. Prittie, Rifle Bgde. German :— Major Schlobach. Hptmann Fouck.	—	1911.	Oct. 30th, 1911.	—	Mt. Sabinio to R. Chizinga.
31	Anglo - Italian (East Africa Protectorate—Italian Somaliland).	375	March 24th, 1891 ..	—	–	–	–	–	Not yet delimited.
31(*a*)	Anglo - Abyssinian (British Somaliland—Abyssinia).		May 14th, 1897, June 4th, 1897.	—	–	–	–	–	Not yet delimited.
32	Anglo-Italian (British Somaliland — Italian Somaliland).	710	March 24th, 1891 ..	—	–	–	–	–	Not yet delimited.
33	Anglo-French (British Somaliland — French Somaliland).	50	February 2nd, 1888 ..	—	–	–	–	–	Not yet delimited.
34	Anglo - Abyssinian (Uganda and East Africa Protectorate—Abyssinia).	760	—	Major H. H. Austin, R.E. Brev.-Major R. G. T. Bright, Rifle Brigade.	1900-01.	–	–	–	–
34	" "	"	—	Capt. P. Maud, R.E. Mr. J. Baird.	Oct. 1902, to July, 1903.	–	–	–	–
34	"	"	December 6th 1907 ..	Major C. W. Gwynn, C.M.G., D.S.O., R.E. Capt. R. L. Waller, R.E.	1908. 1909.	1908. 1909.	–	–	–

35	Anglo-Abyssinian (Sudan—Abyssinia).	760	Treaty, May 15th, 1902	Major H. H. Austin, R.E. Lieut. C. W. Gwynn, R.E.	1900	—	—	—	—
35	" "	"	" " "	Brev.-Major C. W. Gwynn, R.E., D.S.O.	1903.	1903.	—	—	—
36	Anglo-Italian (Sudan—Eritrea).	330	December 7th, 1898, June 1st, 1899, April 16th, 1901, November 22nd, 1901, May 15th, 1902.	British :— Col. the Hon. M. G. Talbot, R.E. Italian :— Major Martinelli. Tenente. A. Pollera. Capt. Tornare.	1903.	1903	—	—	R. Setit to Abu Gamal.
36	"	"	" " "	Brev.-Major W. J. Walter Lancs.Fus.	1899, 1901.	1901	—	—	From Sabderat North - Eastwards.
37	Anglo-French (Sudan—French Equatorial Africa, Congo - Nile Watershed to Tripoli).	1,950	March 21st, 1899 .. Treaty, Series 15, 1899.	—	—	—	—	—	Not yet delimited.
38	Anglo-Italian (Egypt—Tripoli).	1,000	—	—	—	—	—	—	Not yet delimited.
39	Anglo-Turkish (Egypt—Syria) also called Sinai Peninsula Boundary.	140	Firman, 1841	British :— Capt. R. C. Owen. Mr. Wade. Mr. Keeling. Turkish :— Mazzaffer Bey. Fehim Bey.	1906.	1906.	—	Oct. 1st, 1906.	—

VII.

CLASSIFIED LISTS OF THE STAFFS OF SURVEY DEPARTMENTS.

NOTES : * Pensionable. † Signifies free quarters, the value of which, assessed at 10 per cent. of salary, is calculated in pensions (of permanent officers).

(*a*) Duty allowance. (*b*) House allowance. (*c*) Travelling allowance. (*d*) Personal allowance. (*e*) Horse allowance. (*f*) Bicycle allowance. (*g*) Motor-cycle allowance. (*h*) Commuted allowance. (*i*) Tent allowance.

Office.	Name.	Salary. £	Allowances.	Date of First Appointment.	Date of Present Rank.
	EAST AFRICA PROTECTORATE.				
	Superintending Staff.				
Director of Surveys	Capt. G. C. Williams, R.E. ...	800	... ...	5th Nov., 1908 ...	17th July, 1912.
Office Superintendent ...	*Mr. A. Rehm	£245 by £20 to £270.	... ...	4th Jan., 1906 ...	4th Jan., 1906.
Assistant Clerk	Miss E. Rehm	92	... ...	1st Jan., 1909 ...	1st Jan., 1909.
	Trigonometrical and Topographical Survey.				
Deputy Director	Capt. A. M. Coode, R.E. ...	667	... ...	28th May, 1909 ...	17th July, 1912.
Assistant Director	*Capt. H. N. Kempthorne ...	525	... ...	8th Dec., 1911 ...	8th Dec., 1911.
,, ,, ...	Lieut. G. A. P. Maxwell, R.E.	525	... ...	6th June, 1912 ...	6th June, 1912.
Surveyor	2nd Corpl. H. Thornton, R.E.	300	(*b*) £36 p.a.	15th July, 1908 ...	24th Dec., 1912.
,, ...	L.-Corpl. J. P. Durkan, R.E. ...	215	,, ...	15th July, 1908 ...	15th July, 1908.
,, ...	2nd Corpl. F. G. Loxton, R.E.	250	,, ...	29th Dec., 1911 ...	29th Dec., 1911.
,, ...	L.-Corpl. H. O. Jones, R.E. ...	215	,, ...	27th Jan., 1912 ...	27th Jan., 1912.
,, ...	2nd Corpl. A. R. Turner, R.E.	250	,, ...	15th June, 1912	15th June, 1912.
,, ...	L.-Corpl. P. W. Shields, R.E. ...	215	,, ...	24th Jan., 1913 ...	24th Jan., 1913.

		Cadastral Branch—Headquarters.				
Deputy Director	*Mr. A. E. Townsend	500	(*a*) £50 p.a.	12th July, 1905 ...	28th Dec., 1908.
Assistant Director	*Mr. T. H. Galbraith	405	... ...	18th July, 1906 ...	28th Dec., 1908.
Chief Clerk and Accountant	Mr. C. H. Chalk	130–10–200	(*a*) £24 p.a., (*b*) £40 p.a.	11th Oct., 1909 ...	7th July, 1911.
Clerk and Accountant ...	*Mr. W. T. West	120–10–180	,,	4th July, 1908 ...	4th July, 1908.
Clerk	Mr. D. A. Maconochie	130–10–200	,,	9th Nov., 1911 ...	9th Nov., 1911.
,, ...	Mr. A. B. Balmer	130–10–200	,,	21st July, 1912 ...	21st July, 1912.
		Computing Office.			
Chief Computer	Mr. J. H. Williams	300–20–400	... ...	10th August, 1909	1st August, 1910.
Computer	Mr. A. E. Adamson	250–20–350	(*b*) £60 p.a.	9th Nov., 1911 ...	9th Nov., 1911.
,, ...	Mr. F. J. Gosden	250–20–350	,, ...	9th Jan., 1912 ...	1st April, 1913.
,, ...	Mr. J. G. F. McKay	250–20–350	,, ...	25th May, 1911 ...	3rd Dec., 1912.
,, ...	Mr. T. R. L. Nestor	250–20–350	,, ...	23rd Oct. 1912 ...	7th April, 1913.
		Drawing Office.			
Chief Draughtsman	Mr. C. J. B. Panting	250–15–280	(*b*) £60 p.a.	15th August, 1906	15th August, 1906.
Draughtsman	Mr. M. W. Hayes ...	£160 by £15 every three years to £205.	(*b*) £36 p.a. ...	12th Oct., 1911 ...	12th Oct., 1911.
,, ...	Mr. G. Taylor (one vacancy)			9th Jan., 1912 ...	9th Jan., 1912.
		Public Map Office.			
Draughtsman	Mr. G. Bennie	£160 by £15 every three years to £205.	(*b*) £36 p.a.	1st May, 1913 ...	1st May, 1913.
		Cadastral Surveyors.			
District Surveyors	Mr. G. Woodruff	360–20–400	(*b*) £60 p.a., (*c*) Rs. 4 p.d.	12th Sept., 1906 ...	1st July, 1910.
,, ,, ...	Mr. A. G. Baker	360–20–400	,, ,,	28th Aug., 1907 ...	20th June, 1912.
,, ,, ...	(One vacancy)	360–20–400	,, ,,	—	—
Senior Staff Surveyor ...	Mr. A. W. Fraser	300–20–340	,, ,,	24th July, 1911 ...	1st Feb., 1913.
,, ,, ,, ...	Mr. F. S. O'Molony	300–20–340	,, ,,	22nd Jan., 1912 ...	1st Feb., 1913.
,, ,, ,, ...	Mr. E. K. Boileau	300–20–340	,, ,,	1st Feb., 1907 ...	1st April, 1913.
,, ,, ,, ...	(One vacancy)	300–20–340	,, ,,	—	—

Office.	Name.	Salary. £	Allowances.	Date of First Appointment.	Date of Present Rank.
	EAST AFRICA—*continued.*				
	Cadastral Surveyors—continued.				
Junior Staff Surveyors (Two Supernumerary).	Mr. J. Marsengo	250–15–280	(*b*) £60 p.a. (*c*) Rs. 4 p.d.	1st April, 1907 ...	1st April, 1907.
,, ,, ,,	Mr. A. Bessler	250–15–280	,, ,,	17th Dec., 1906 ...	14th Sept., 1908.
,, ,, ,,	Mr. H. C. Anderson	250–15–280	,, ,,	8th August, 1908	1st July, 1910.
,, ,, ,,	Mr. W. MacDonald	250–15–280	,, ,,	14th Sept., 1911...	14th Sept., 1911.
,, ,, ,,	Mr. C. T. Ogle	250–15–280	,, ,,	2nd August, 1912	2nd August, 1912.
,, ,, ,,	Mr. G. C. Oakes	250–15–280	,, ,,	7th Dec., 1911 ...	3rd Dec., 1912.
,, ,, ,,	Mr. S. H. Ramsey	250–15–280	,, ,,	12th August, 1912	1st Feb., 1913.
,, ,, ,,	Mr. E. W. Nelson	250–15–280	,, ,,	9th April, 1913 ...	9th April, 1913.
Assistant Junior Staff Surveyors.	Mr. A. W. Morris	120	(*b*) £36 p.a., (*c*) Rs. 2·50 p.d.	14th Sept., 1911...	14th Sept., 1911.
,, ,, ,,	Mr. I. Lewison	120	,, ,,	1st Feb., 1911 ...	1st Dec., 1911.
,, ,, ,,	Mr. W. N. Low	120	,, ,,	1st March, 1907...	7th Nov., 1912.
	Coast Land Settlement.				
Senior Staff Surveyors ...	(Two vacancies)	300–20–340	(*b*) £60 p.a., (*c*) Rs. 4 p.d.	—	—
Junior Staff Surveyors (Two Supernumerary).	Mr. G. E. Weston	250–15–280	,, ,,	12th Oct., 1911 ...	12th Oct., 1911.
,, ,, ,,	Mr. W. V. Coates	250–15–280	,, ,,	12th Oct., 1911 ...	12th Oct., 1911.
,, ,, ,,	Mr. H. M. Thornhill	250–15–280	,, ,,	16th July, 1912...	16th July 1912.
,, ,, ,,	Mr. W. R. Piers	250–15–280	,, ,,	12th August, 1912	12th Aug., 1912.
,, ,, ,,	Mr. C. O. Gilbert	250–15–280	,, ,,	16th Sept., 1912...	16th Sept., 1912.
,, ,, ,,	Mr. F. B. Ballenden	250–15–280	,, ,,	28th August, 1912	28th Aug., 1912.
Assistant Junior Staff Surveyors.	Mr. C. E. Taylor	120	(*b*) £36 p.a., (*c*) Rs. 2·50 p.d.	1st Sept., 1910 ...	1st Sept., 1910.
,, ,, ,,	Mr. W. C. Tappin	120	,, ,,	14th Sept., 1911...	14th Sept., 1911.
,, ,, ,,	Mr. E. J. Dent	120	,, ,,	6th June, 1912 ...	6th June, 1912.

Computers	Mr. J. H. McEwen	250–20–350	(*b*) £60 p.a.	20th Dec., 1911 ...	20th Dec., 1911.
	Mr. L. C. Wright	250–20–350	„	21st April, 1913...	21st April, 1913.
Draughtsman...	Mr. A. Fischer	£160 by £15 every 3 years to £205.	(*b*) £36 p.a.	2nd June, 1913 ...	2nd June, 1913.
„	(One vacancy)	„ „	„	—	—
	GOLD COAST.				
	Headquarters.				
Director of Surveys ...	Capt. E. F. W. Lees, R.E. ...	800	(*a*) £160 p.a.; (*e*) £30 p.a.	4th Jan., 1908 ...	4th Jan., 1908.
*Clerk (3rd Grade)	Mr. A. F. Benson	85	... ...	1st Jan., 1902 ...	1st Jan., 1913.
	Topographical Branch.				
Assistant Director of Surveys	Capt. H. A. Lewis Hall, R.E....	400–20–500	(*a*) £80 p.a. ; (*h*) £120...	18th May, 1910...	18th May, 1910.
„ „ „	Capt. P. J. Mackesy, R.E. ...	600	... ...	8th Feb., 1911 ..	26th Feb., 1912.
Surveyor	Corpl. A. S. Jones, R.E. ...	250–10–300	(*h*) £90	20th June, 1909	20th June, 1909.
„	Sapper B. J. Gee, R.E. ...	240	(*h*) £90	8th Feb., 1911 ...	1st October, 1911.
„	L.-Corpl. E. G. L. Allen, R.E.	240	(*h*) £90	8th Feb., 1911 ...	21st April, 1912.
„	Sapper W. O'Connell, R.E.	190	(*h*) £90	8th Feb., 1911 ...	21st April, 1912.
„	Sapper L. V. Tibballs, R.E. ...	190	(*h*) £90	19th Dec., 1912...	19th Dec., 1912.
„	Vacant	190	(*h*) £90	—	—
	Cadastral Branch.				
°Chief Surveyor	Mr. G. V. Mathieson	250–10–300	(*h*) £120...	4th Jan., 1908 ...	4th Jan., 1908.
*Surveyor	Mr. R. N. Kilby	250–10–300	(*h*) £120...	4th Jan., 1908 ...	4th Jan., 1908.
„	Sapper W. H. Oliver	190	(*h*) £90	19th Dec., 1908...	19th Dec., 1912.
„	Vacant	190	(*h*) £90	—	—
„	Vacant	190	(*h*) £90	—	—
*Native Surveyor	Mr. K. Arnsats-Kwanweng ...	200–10–250	(*i*) 2*s.* p.d.	1st Jan., 1908 ...	15th Sept., 1911.
°Native Assistant Surveyor	Mr. E. J. Smith	120–5–150	(*i*) 1*s.* p.d.	1st Jan., 1908 ...	1st Jan., 1908.
° „ „ „	Mr. H. E. Sogoe	120–5–150	(*i*) 1*s.* p.d.	1st May, 1910 ...	1st May, 1910.
Draughtsman...	Sapper A. F. R. Morris, R.E....	250–10–300	... .	6th April, 1910 ...	6th April, 1910.
... ...	Vacant	250	—	—	—

Office.	Name.	Salary. £	Allowances.	Date of First Appointment.	Date of Present Rank.
	NORTHERN NIGERIA.				
Chief Surveyor	*Mr. A. S. Collard	600	(*a*) £100, (*e*) 2*s.* 6*d.* p.d.	16th Dec., 1911 ...	16th Dec., 1911.
Surveyor	*Mr. T. J. Waters	400	(*a*) £80, (*e*) 2*s.* 6*d.* p.d.	3rd Oct., 1912 ...	3rd Oct., 1912.
„	L.-Corpl. R. R. Rowland, R.E.	200	(*e*) 1*s.* 9*d.* p.d.	29th March, 1911	29th March, 1911.
„	L.-Corpl. C. C. Crock, R.E. ...	200	„	29th March, 1911	29th March, 1911.
„	L.-Corpl. C. Renshaw, R.E. ...	190	„	7th August, 1912	7th August, 1912.
„	L.-Corpl. W. Norton, R.E. ...	190	„	7th August, 1912	7th August, 1912.
Cartographer	L.-Corpl. J. F. Fleming, R.E. ...	201	Cycle allowance £8 p.a.	28th August, 1912	28th August, 1912.
Cartographer (Native) ...	*Mr. I. O. Gilbert	200	... ...	1st June, 1904 ...	1st June, 1904.
Draughtsman (Native) ...	*Mr. A. C. Freeman	120	... ...	31st August, 1912	31st August, 1912.
	SOUTHERN NIGERIA.				
	Headquarters.				
Acting Surveyor-General of Nigeria and Director of Surveys, S.N.	Major F. G. Guggisberg, R.E., C.M.G.	900	(*a*) £180 p.a., † (*c*) ...	1st April, 1910 ...	1st April, 1910.
Office Superintendent ...	Mr. S. Boulderson	280–20–380	† (*c*)	15th July, 1911 ...	1st June, 1912.
Chief Clerk	*D. Akitoye	252–12–300	... ...	16th August, 1886	1st Jan., 1911.
1st Class Clerk	*A. E. Carrena	96–6–150	... ...	1 Dec., 1902 ...	1st Jan., 1913.
Finance Clerk	*J. S. Williams	60–6–90	... ...	1 Dec., 1902 ...	1st Jan., 1911.
Store Clerk	*J. F. Kiyonmi	60–6–90	... ...	27th Dec., 1905 ...	1st Jan., 1912.
Director's Clerk	... ...	24–6–54	... ...	—	—
Temporary Clerk	E. A. Delalu	72	... ...	1st Nov., 1907 ...	1st Jan., 1912.
	Topographical Branch.				
Deputy Director of Surveys, Topographical Branch.	Capt. R. H. Rowe, R.A. ...	525	† (*c*)	1st June, 1907 ...	20th Sept., 1911

Assistant Director, Trigonometrical Section.	Lieut. G. G. Waterhouse, R.E.	525	†(c)	10th August, 1910	10th August, 1910.
Assistant Director, Topographical Branch.	Lieut. H. E. Kentish, R.E. ...	525	†(c)	30th Nov., 1910...	30th Nov., 1910.
" " "	Lieut. G. H. Bell, S. Lancs. Regt.	525	†(c)	29th Sept., 1909...	11th April, 1912.
" " "	Lieut. J. Dare, L.N. Lancs. Regt.	525	†(c)	20th Sept., 1912...	20th Sept., 1912.
Surveyor	Mr. E. N. Thomas	360–20–400	†(c)	16th May, 1908...	1st Jan., 1911.
"	Co. Sjt.-Maj. K. J. Hackett, R.E.	290	†(c)	10th August, 1910	20th Sept., 1912.
"	L.-Corpl. J. Gawthorne, R.E....	200	†(c)	10th August, 1910	10th August, 1910.
"	2nd Corpl. R. Hosking, R.E. ...	225	†(c)	20th Sept., 1911...	20th Sept., 1911.
"	L.-Corpl. H. Clark, R.E. ...	200	†(c)	10th August, 1910	10th August, 1910.
"	L.-Corpl. C. Wharton, R.E. ...	200	†(c)	10th August, 1910	10th August, 1910.
"	L.-Corpl. A. Mullin, R.E. ...	200	†(c)	10th August, 1910	10th August, 1910.
"	L.-Corpl. W. Elliott, R.E. ...	200	†(c)	20th Sept., 1912...	20th Sept., 1912.
"	L.-Corpl. R. T. Sarson, R.E. ...	200	†(c)	20th Sept., 1911...	20th Sept., 1911.
"	L.-Corpl. H. Locke, R.E. ...	200	†(c)	20th Sept., 1912...	20th Sept., 1912.
Chief Native Surveyor ...	*J. C. Johnston	200–10–250	(c)	16th July, 1900...	1st April, 1911.
2nd Class Native Surveyor ...	A. O. Craig	72–6–90	(c)	1st July, 1908 ...	1st Jan., 1911.
2nd Class Native Surveyor ...	*G. H. Euba	72–6–90	(c)	1st July, 1908 ...	1st Jan., 1911.
3rd Class Native Surveyor ...	*E. S. S. Wood	48–6–60	(c)	1st July, 1908 ...	1st Jan., 1911.
" " " ...	*E. O. Aiyede	48–6–60	(c)	1st July, 1908 ...	1st Jan., 1911.
4th Class Native Surveyor ...	J. B. Cole	40–4–48	(c)	1st July, 1908 ...	1st Jan., 1911.
" " " ...	R. A. Williams	40–4–48	(c)	1st July, 1908 ...	1st Jan., 1911.
" " " ...	A. A. Young	40–4–48	(c)	1st July, 1909 ...	1st Jan., 1911.
" " " ...	S. A. O. Isaacs	40–4–48	(c)	1st Jan., 1908 ...	1st Jan., 1911.
" " " ...	A. O. Pedro	40–4–48	(c)	1st July, 1909 ...	1st July, 1912.
" " " ...	H. R. Hoskyns	40–4–48	(c)	1st July, 1909 ...	1st July, 1912.
" " " ...	J. L. Tete	40–4–48	(c)	1st July, 1912 ...	1st July, 1912.
Chief Native Draughtsman and Map Curator.	*J. A. Pratt	164–12–240	... ...	1st Jan., 1912 ...	1st Jan., 1912.
1st Class Native Draughtsman	*G. J. Goyea	96–6–150	... ...	18th August, 1902	1st Jan., 1911.

Office.	Name.	Salary. £	Allowances.	Date of First Appointment.	Date of Present Rank.
	SOUTHERN NIGERIA—*continued.*				
	***Topographical Branch*—continued.**				
4th Class Native Draughtsman	A. L. Ajiboye	40–4–48	... ...	1st July, 1912 ...	1st July, 1912.
" " " ...	W. F. Durosimi	40–4–48	... ...	1st October, 1912	1st October, 1912.
" " " ...	W. F. Sancho	40–4–48	... ...	1st October, 1912	1st October, 1912.
Probationer Draughtsman ...	T. A. Adu	12	... ...	1st October, 1912	1st October, 1912.
	Cadastral Branch.				
Deputy Director of Surveys	*Mr. A. Cleminson	500–2–600	(*a*) £100 p.a., † (*c*) ...	10th Jan., 1901 ...	29th October, 1906.
Lands Surveyor	*Mr. R. L. Drouyn	400–20–500	(*a*) £80 p.a., † (*c*) ...	13th October, 1906	1st Jan., 1912.
" "	*Mr. R. A. Webb	400–20–500	(*a*) £80 p.a., † (*c*) ...	23rd Sept., 1905...	11th July, 1912.
Draughtsman...	Serjt. E. H. Allen, R.E. ...	275	... ...	26th Jan., 1913 ...	26th Jan., 1913.
1st Class Native Surveyor ...	*I. T. Wey	96–6–150	... ...	1st October, 1902	1st Jan., 1911.
3rd Class Native Surveyor ...	*R. Jones...	48–6–60	... ...	1st Jan., 1911 ...	1st Jan.. 1911.
4th Class Native Surveyor ...	O. Olumide	40–4–48	... ...	1st April, 1911 ...	1st April, 1911.
1st Class Native Draughtsman	*A. A. Creppy	96–6–150	... ...	1st Jan., 1904 ...	1st Jan., 1911.
2nd Class Native Draughtsman	*H. St. J. Williams	72–6–90	... ...	1st April, 1904 ...	1st April, 1911.
4th Class Native Draughtsman	D. A. Mendes	40–4–48	... ...	1st Jan., 1912 ...	1st Jan., 1912.
" " "	J. C. Elias	40–4–48	... ...	1st October, 1911	1st July, 1912.
" " "	... ...	40–4–48	... ...	—	—
3rd Class Clerk	*G. S. Wilson	24–6–54	... ...	1st Jan., 1911 ...	1st Jan., 1911.
	Special Cadastral Party.				
Superintendent	Mr. W. Wilson	400–20–500	(*a*) £80†...	16th August, 1911	16th August, 1912.
Surveyor	L.-Cpl. P. A. Godwin, R.E. ...	200	†...	16th August, 1911	16th August, 1912.
"	L.-Cpl. S. Router, R.E. ...	200	†...	16th August, 1911	16th August, 1912.
"	L.-Cpl. C. Smith. R.E.... ...	200	†...	16th August, 1911	16th August, 1912.
"	L.-Cpl. A. Carr, R.E.	200	†...	16th August, 1911	16th August, 1912.
"	L.-Cpl. W. McIlroy, R.E. ...	200	†...	16th August, 1911	16th August, 1912.
"	L.-Cpl. E. J. Kinch, R.E. ...	200	†...	16th August, 1911	16th August, 1912.

		School and Meteorological.				
Chief Instructor	C. A. A. Barnes	252–12–300	... ...	1st May, 1908 ...	1st Jan., 1911.
Meteorological Clerk ...	E. E. Solomon	24–6–54	... ...	1st Jan., 1908 ...	1st Jan., 1911.
,, ,, ...	M. I. Oke	24–6–54	... ...	1st Oct., 1912 ...	1st Oct., 1912.
Pupil Surveyor	H. M. Williams...	30	... ...	1st July, 1910 ...	1st July, 1911.
,, ,, ...	A. C. B. Cole	30	... ...	1st July, 1910 ...	1st July, 1911.
,, ,, ...	C. B. A. John	30	... ...	1st July, 1910 ...	1st July, 1911.
,, ,, ...	J. J. Medieros	30	... ...	1st July, 1910 ...	1st July, 1911.
,, ,, ...	V. O. Williams	30	... ...	30th Sept., 1911...	1st Oct., 1911.
,, ,, ...	M. J. Martins	30	... ...	30th Sept., 1911...	1st Oct., 1911.
,, ,, ...	S. O. John	30	... ...	30th Sept., 1911...	1st Oct., 1911.
,, ,, ...	F. G. Martins	30	... ...	30th Sept., 1911...	1st Oct., 1911.
,, ,, ...	N. Thompson	30	... ...	30th Sept., 1911...	1st Oct., 1911.
,, ,, ...	A. T. Adele	30	... ...	16th Nov., 1911...	16th Nov., 1911.
,, ,, ...	A. R. Balogun	20	... ...	1st Oct., 1911 ...	1st Oct., 1912.
,, ,, ...	R. C. Porter	20	... ...	2nd Jan., 1911 ...	1st Oct., 1912.
,, ,, ...	J. A. S. Cole	20	... ...	2nd Jan., 1911 ...	1st Oct., 1912.
,, ,, ...	J. G. Cole	20	... ...	2nd Jan., 1911 ...	1st Oct., 1912.
,, ,, ...	Y. A. Fahm	20	... ...	2nd Jan., 1911 ...	1st Oct., 1912.
,, ,, ...	G. Johnson	20	... ...	2nd Jan., 1911 ...	1st Oct., 1912.
,, ,, ...	A. Remavor	20	... ...	2nd Jan., 1911 ...	1st Oct., 1912.
,, ,, ...	J. W. Afere	20	... ...	1st Oct., 1912 ...	1st Oct., 1912.
,, ,, ...	E. S. Cole	20	... ...	1st Oct., 1912 ...	1st Oct., 1912.
Pupil Draughtsman	W. A. Hollist	20	... ...	1st Oct., 1911 ...	1st Oct., 1911.

(*c*) In the case of the more senior appointments, travelling allowance varies from 10*s*. to 5*s*. for each night's absence from headquarters, according to salary :—*I.e.*, between £200 and £600 p.a., 5*s*. ; over £600 p.a., 10*s*.

		NYASALAND.			
Director of Public Works and Survey.	*Mr. T. I. Binnie	£500 by £25 to £700.	(*a*) £50 p.a., (*i*) 2*s*. 6*d*. p.d.	15th March, 1897	1st Dec., 1900.
Assistant Director of Public Works and Survey.	°Mr. T. F. Firr	£400 by £20 to £500.	(*a*) £40 p.a., (*i*) 2*s*. 6*d*. p.d.	28th May, 1902 ...	1st Jan., 1910.
Assistant Surveyor	*Mr. J. Bannerman	£325 by £20 to £425.	(*i*) 2*s*. 6*d*. p.d.	20th June, 1901...	1st April, 1912.

Office.	Name.	Salary. £	Allowances.†	Date of First Appointment.	Date of Present Rank.
	UGANDA (July 1st, 1913).				
Directors of Surveys ...	*Mr. R. C. Allen	700–25–800	(*a*) £70, (*d*) £100 ...	23rd Nov., 1900 ...	23rd Nov., 1900.
Deputy Director	*Mr. H. Boazman	400–20–500	(*a*) £40	18th July, 1903...	1st Sept., 1912.
District Surveyors	*Mr. E. Richardson	360–20–400	... ...	8th April, 1904 ...	16th Nov., 1907
,, ,, ...	*Mr. L. R. Fraser	360–20–400	... ...	18th April, 1904	24th Dec., 1907.
,, ,, ...	*Mr. E. G. Fenning	360–20–400	... ...	29th April, 1904	24th Dec., 1907.
,, ,, ...	*Mr. J. P. Tolland	360–20–400	... ...	23rd Nov., 1906...	1st Sept., 1912.
Senior Staff Surveyor ...	*Mr. A. H. Gee	300–20–340	... ...	3rd March, 1907	1st Sept., 1912.
Junior Staff Surveyors ...	*Mr A. Richardson	300	(*d*) £50	1st June, 1903 ...	1st June, 1903.
,, ,, ,, ...	*Mr. J. W. T. S. McGregor ...	300	(*d*) £50	16th July, 1903...	16th July, 1903.
,, ,, ,, ...	Mr. J. G. Strickland	250–15–280	... ...	4th Nov., 1910 ...	22nd May, 1911.
,, ,, ,, ...	Mr. C. H. Vaughan ... ... (Two vacancies).	250–15–280	... ...	28th March, 1912	28th March, 1912.
Survey Probationers... ...	Mr H. B. Thomas	250	... ...	9th Nov., 1911 ...	9th Nov., 1911.
,, ,, ...	Mr. J. M. Y. Trotter	250	... ...	26th April, 1912	26th April, 1912.
,, ,, ...	Mr. A. C. McHatton	250	... ...	23rd Oct., 1912 ...	23rd Oct., 1912.
,, ,, ...	Mr J. G. Foulds	250	... ...	30th Jan., 1913 ...	30th Jan., 1913.
,, ,, ...	Mr. D. J. McHatton	250	... ...	22nd May, 1913...	22nd May, 1913.
,, ,, ...	Mr. A. R. G. Hart	250	... ...	22nd May, 1913...	22nd May, 1913.
Indian Assistant Surveyor	Wahid Ali Khan, K.S. ...	300	... ...	27th March, 1901	27th March, 1901.
Draughtsman...	Mr. F. C. Macdonald	180–10–200	... ...	22nd July, 1910	22nd July, 1910.
Head Clerk and Storekeeper	Mr. W. L. Freemantle... ...	180–10–200	... ...	1st Feb., 1908 ...	22nd July, 1908.
Clerk	Mr. W. J. Lowings	150–10–200	... ...	28th March, 1912	28th March, 1912.
	BRITISH HONDURAS.				
Surveyor General	*Mr. H. T. Perkins, I.S.O. ...	$3,402	... ...	1880 ...	18th Oct., 1905.
Assistant Surveyor-General	*Mr. W. H. Carlin	$1,944	... ...	1st April, 1896 ...	1st April, 1896.
Assistant Surveyor	*Mr. F. W. Brunton	$1,458	... ...	1903 ...	1st April, 1906.

† European surveyors in Uganda when at a recognised station draw an allowance in lieu of quarters if not provided with house or other accommodation. Travelling allowance at the rate of Rs. 4 a day will be issued from 1st April, 1914.

Assistant Surveyor	*Mr. L. E. Williams	1,458	... ...	1st Jan., 1906 ...	1st Jan., 1906.
" "	*Mr. C. La T. Franks	1,458	... ...	25th Feb., 1907 ...	25th Feb., 1907.
Temporary Surveyor ...	Mr. C. L. Ridley	1,458	... ...	1st Jan., 1909 ...	1st Jan., 1909.
Forest Officers	*Mr. J. L. Brown	600–60–900	... ...	1st June, 1896 ...	1st June, 1896.
" "	*Mr. G. W. Hulse	600–60–840	... ...	1st Jan., 1910 ...	1st Jan., 1910.
First Clerk Clerk	*Mr. D. L. Rosado	720–40–960	... ...	1894 ...	1st April, 1911.
Tracer...	*Mr. I. C. Hulse...	360–20–480	... ...	1st May, 1911 ...	1st May, 1911.
		CEYLON. Rs.			
Surveyor General	*Mr. R. S. Templeton	13,500–56,250 –16,875.	... ...	15th October, 1887	15th October, 1910.
		£			
Deputy Surveyor General ...	*Mr. W. C. S. Ingles	750–50–900	(*b*) Rs. 1,320 p.a. ...	4th Jan., 1890 ...	15th October, 1910
Accountant	*Mr. W. C. Howard Tripp ...	400–25–500	(*b*) Rs. 702 p.a.	15th July, 1911...	15th July, 1911.
Superintendent Application Surveys.	*Mr. A. J. Wickwar	600–50–750	(*b*) Rs. 844 p.a.	1st Sept., 1889 ...	1st Jan., 1905.
Superintendent of Surveys ...	*Mr. L. Shipton	600–50–750	... ...	4th Sept., 1884 ...	1st May, 1910.
Superintendent of Waste Lands.	*Mr. A. H. G. Dawson	600–50–750	(*b*) Rs. 581 p.a.... ...	16th Dec., 1895 ...	1st August, 1911.
Superintendent of Surveys ...	*Mr. C. F. W. Halliley	600–50–750	... ...	1st March, 1891...	15th August, 1912.
" " ...	*Vacant	—	—	—	—
" " ...	*Mr. C. R. Lundie	450–30–600	(*b*) Rs. 506 p.a.... ...	13th Feb., 1904 ...	1st May, 1910.
" " ...	°Mr. A. J. Stronach	450–30–600	... ...	30th June, 1906...	15th October, 1910.
" " ...	*Mr. G. K. Thornhill	450–30–600	... ...	15th July, 1901...	1st Sept., 1911.
" " ...	*Mr. D. Bloxham	450–30–600	... ...	5th October, 1907	1st August, 1911.
" " ...	*Mr. C. H. Vince	450–30–600	(*f*) Rs. 7.50 p.m. ...	13th June, 1908...	15th August, 1912.
Superintendent Observatory	*Mr. A. J. Bamford	600–50–750	(*b*) Rs. 675 p.a.... ...	31st October, 1908	1st Jan., 1913.
Assistant Astronomer ...	*Mr. J. E. Evans	300–20–400	(*b*) Rs. 577 p.a.... ...	4th Jan., 1913 ...	4th Jan., 1913.
" " ...	Vacant	—	—	—	—
Assistant Superintendent of Surveys.	*J. W. Robertson	300–25–350 and, after four years on 350, 375 –25–400.	(*f*) Rs. 7.50 p.m. ...	17th June, 1885...	1st May, 1897.

Office.	Name.	Salary. £	Allowances.	Date of First Appointment.	Date of Present Rank.
	CEYLON—*continued.*				
Assistant Superintendent of Surveys.	*Mr. A. E Dirkckze	300–25–350 and, after four years on 350, 375–25–400.	... ...	1st October, 1889	12th May, 1906.
" " "	*Mr. F. J. Salmon	"	(*b*) Rs. 394 p.a.... ...	13th June, 1908...	13th June, 1908.
" " "	*Mr. L. G. O. Woodhouse ...	"	(*b*) Rs. 394 p.a.... ...	1st August, 1905	8th Sept., 1908.
			(*g*) Rs. 35 p.m.		
" " "	*Mr. E. B. Manson	"	(*g*) Rs. 35 p m.	13th June, 1908...	13th June, 1908.
" " "	*Mr. R. W. E. Ruddock ...	"	... ...	5th Nov., 1908 ...	5th Nov., 1908.
" " "	*Mr. N. B. Favell	"	... ...	6th May, 1909 ...	6th May, 1909.
" " "	*Mr. P J. May	"	... ...	6th May, 1909 ...	6th May, 1909.
" " "	*Mr. F. L. Baker	"	... ...	6th May, 1909 ...	6th May, 1909.
" " "	*Mr. E. O. de Fonseka	"	(*f*) Rs. 7.50 p.m. ...	1st April, 1897 ...	1st Sept., 1912.
			(*b*) Rs. 495 p.a.... ...		
" " "	Mr. K. W. S. Mitchell... ...	"	(*g*) Rs. 35 p.m.... ...	6th May, 1909 ...	6th May, 1909.
" " "	Mr. H. P. Harrison	"	Rs. 45 p.m.	20th May, 1909 ...	20th May, 1909.
" " "	Mr. H. O. Clark	"	Rs. 394 p.m. ...	21st October, 1909	21st October, 1909.
" " "	Mr. C. C. S. Stephenson ...	"	(*g*) Rs. 35 p.m.	21st October, 1909	21st October, 1907.
" " "	Mr. P. E. L. Gethin	"	(*g*) Rs. 35 p.m.	1st April, 1910 ...	1st April, 1910.
" " "	Mr. S. Easten	"	(*f*) Rs. 7.50 p.m. ...	11th August, 1911	11th August, 1911.
" " "	Mr. B. S. Coventry	"	" " ...	19th Nov., 1909 ...	19th Nov., 1909.
" " "	Mr. G. B. Manson	"	... ...	4th Nov., 1911 ...	4th Nov., 1911.
" " "	Mr. L. E. S. Mitchell	"	(*g*) Rs. 35 p.m.	4th Nov., 1911 ...	4th Nov., 1911.
" " "	Mr. W. Adam	"	(*e*) Rs. 45 p.m.	20th Jan., 1912 ...	20th Jan., 1912.
" " "	Mr. J. Ferguson	"	" "	3rd May, 1912 ...	3rd May, 1912.
" " "	Mr. C. W. F. Wavell	"	... ...	3rd May, 1912 ...	3rd May, 1912.
" " "	Mr. R. J. Johnston	"	... ...	4th Jan., 1913 ...	4th Jan., 1913.

" " "	Mr. T. Y. Price	"	... ...	4th Jan., 1913 ...	4th Jan., 1913.
" " "	Mr. J. Moriarty	"	... ...	4th Jan., 1913 ...	4th Jan., 1913.
" " "	Mr. P. Mc. C. Thornhill ...	"	... ...	10th Jan., 1913 ...	10th Jan., 1913.
" " "	Mr. L. M. Symes	"	... ...	10th Jan., 1913 ...	10th Jan., 1913.
" " "	Mr. W. A. Davis	"	(*f*) Rs. 7.50 p.m. ...	10th Jan., 1913 ...	10th Jan., 1913.
" " "	Mr. W. W. Bentley	"	" " ...	8th Feb., 1913 ...	8th Feb., 1913.
" " "	Mr. C. D. Day	"	... ...	30th May, 1913 ...	30th May, 1913.
" " "	Mr. E. J. Whitehead	"	... ...	30th May, 1913 ...	30th May, 1913.
" " "	Vacant	——	——	——	——
" " "	Vacant	——	——	——	——
Assistant Superintendent of Surveys, Non-Commissioned Officers of the Royal Engineers.	Sergt. H. W. Johnson	300–10–350	(*b*) Rs. 561 p.a.	22nd May, 1908 ...	22nd May, 1908.
" " "	L.-Corpl. F. E. Dainty ...	250–10–300	(*c*) Rs. 60 p.a.	5th June, 1908 ...	5th June, 1908.
" " "	Sapper C. A. Robertson ...	300–10–350	" "	5th June, 1908 ...	5th June, 1908.
" " "	Corpl. W. F. Hawkesworth ...	"	(*b*) Rs. 561 p.a.	18th June, 1909 ...	18th June, 1909.
" " "	Corpl. W. S. Maddams ...	"	" "	18th June, 1909 ...	18th June, 1909.
" " "	Sergt. A. Plested	"	(*b*) Rs. 528 p.a.	9th Sept., 1910 ...	9th Sept., 1910.
" " "	2nd Corpl. A. T. Burgess ...	"	(*b*) Rs. 495 p.a.	4th Oct., 1912 ...	4th Oct., 1912.
" " "	Vacant	——	——	——	——
Assistant Superintendent of Surveys (Process Dept.).	Mr. W. W. A. Wall	300–10–350	(*b*) Rs. 382 p.a.	5th Nov., 1908 ...	5th Nov., 1908.
		CYPRUS.			
Register-General ... ... (Ex-officio Director of Surveys).	*Mr. F. Ongley	——	——	——	——
Assistant Director of Survey	*Mr. B. T. Watts	400	... ...	8th May, 1912 ...	8th May, 1912.
Chief Surveyor	*Mr. G. A. Douglas	240	Forage 1s. p.d.	1st April, 1905 ...	1st April, 1905.
" "	*Mr. G. W. Spencer	250;	Forage 1s. p.d.	5th May, 1911 ...	1st April, 1912.
Ordnance Surveyor	*Mr. J. W. Hart	200	... ...	1st April, 1905 ...	1st April, 1912.

Office.	Name.	Salary.	Allowances.	Date of First Appointment.	Date of Present Rank.
	FIJI. (*Trigonometrical Survey.*)				
Officer in Charge	Mr. G. T. McClaw	500	£100 consolidated ...	15th Dec., 1909 ...	15th Dec., 1909.
" "	Mr. T. Rimmer...	350	£75	24th Sept., 1908	24th Sept., 1908.
	HONG KONG.				
Principal Land Surveyor ...	*L. C. Rees	£510 to £540 by triennial increments of £30.	(*a*) £60 p.a., (*c*) $360 p.a.	6th Nov., 1901 ...	6th Nov., 1901.
1st Grade Surveyor ...	*B. W. Grey	450–10–480	(*a*) £40 p.a., (*c*) $360 p.a.	1st May, 1899 ...	1st Jan., 1913.
" " ...	*E. B. Reed	450–10–480	(*a*) £40 p.a., (*c*) $360 p.a.	28th Oct., 1905 ...	1st Jan., 1913.
2nd Grade Surveyor	*F. Sutton	360–10–420	(*c*) £40 p.a., (*c*) $360 p.a.	20th June, 1908	1st Jan., 1913.
Surveyor	*H. West	360–10–420	(*c*) $360 p.a., also $10 p.m., horse allowance and free quarters while in the New Territories.	1st July, 1910 ...	1st Jan., 1913.
"	*H. C. Lowick	360–10–420	(*c*) $360 p.a.	23rd Sept., 1910	1st Jan., 1913.
"	*H. S. Rouse	330–10–420	(*c*) $360 p.a.	1st Feb., 1912 ...	1st Jan., 1913.
"	*W. A. J. Cooper	330–10–420	(*c*) $360 p.a.	12th July, 1912...	1st Jan., 1913.
"	*J. S. Chalmers	330–10–420	(*c*) $360 p.a.	14th Dec., 1912 ...	—

NOTE.—The above duty allowances are payable twelve months after attaining maximum salary.

	JAMAICA.				
Surveyor-General	*Mr. C. Liddell	500	... ...	1st Oct., 1890 ...	—
Assistant Surveyor	*Mr. W. A. Baker	250–10–300	... ...	1st April, 1903 ...	—
Second Assistant Surveyor ...	Mr. H. D. Rogers	250	... ...	17th April, 1905	—

Third Assistant Surveyor ...	Mr. R. S. Biscoe	250	... ...	15th April, 1912	—
Accountant and 2nd Class Clerk.	*Mr. E. G. Wilson	180	... ...	1st March, 1893...	—
Assistant Clerk	Mr. V. N. Smith	£99 10*s.* 0*d.*	... ...	19th Feb., 1909 ...	—
FEDERATED MALAY STATES (31st December, 1912).					
Surveyor-General	Col. H. M. Jackson	*1,050-50-1,200.	(*a*) £200 p.a.	28th August, 1908	28th August, 1908.
Deputy Surveyor-General ...	Vacant	*750–25–800	(*a*) £150 p.a.	—	—
Superintendents	J. P. Harper	*650–25–800	(*a*) £125 p.a.	2nd Sept., 1889 ...	1st Jan., 1898.
,, ...	H. R. Shaw	*650–25–800	,, ,, ...	27th June, 1890...	1st April, 1900.
,, ...	C. M. Goodyear...	*650–25–800	,, ,, ...	1st May, 1902 ...	18th May, 1909.
,, ...	E. W. Hedgeland	*650–25–800	,, ,, ...	3rd Jan., 1907 ...	1st Jan., 1909.
,, ...	E. J. Kemplen	*650–25–800	,, ,, ...	18th Dec., 1891 ...	17th August, 1910.
,, ...	V. A. Lowinger...	*650–25–800	,, ,, ...	10th August, 1906	1st Jan., 1913.
Deputy Superintendent ...	L. U. Stafford	*540–15–600	(*a*) £100 p.a.	1st Sept., 1900 ...	31st March, 1911.
Assistant Superintendents ...	E. Sweney	*480–15–540	,, ,, ...	22nd Sept., 1898...	22nd Sept., 1898.
,, ,, ...	E. G. Wood	*480–15–540	,, ,, ...	1st Jan., 1899 ...	1st Jan., 1899.
,, ,, ...	E. W. Geyer	*480–15–540	,, ,, ...	4th Feb., 1902 ...	4th Feb., 1905.
,, ,, ...	C. J. Perkins	*480–15–540	,, ,, ...	8th Feb., 1904 ...	11th May, 1906.
,, ,, ...	W. A. Wallace	*480–15–540	,, ,, ...	8th Feb., 1904 ...	10th March, 1906.
,, ,, ...	F. J. Gore	*480–15–540	,, ,, ...	23rd Jan., 1904 ...	1st Jan., 1907.
,, ,, ...	E. E. P. Clare	*480–15–540	,, ,, ...	1st May, 1899 ...	17th June, 1907.
,, ,, ...	J. N. Sheffield	*480–15–540	,, ,, ...	14th Sept., 1896...	1st Jan., 1909.
,, ,, ...	F. R. Twiss	*480–15–540	,, ,, ...	21st June, 1906...	1st Jan., 1909.
,, ,, ...	A. A. Campbell...	*480–15–540	,, ,, ...	15th June, 1899...	8th July, 1910.
,, ,, ...	J. Bowes	*480–15–540	,, ,, ...	18th Jan., 1902 ...	1st Oct., 1910.
,, ,, ...	T. Le Fevre	*480–15–540	,, ,, ...	1st August, 1902	1st Oct., 1910.
,, ,, ...	G. A. Hodges	*480–15–540	,, ,, ...	29th March, 1898	1st April, 1911.
,, ,, ...	R. L. Buckwell	*480–15–540	,, ,, ...	31st Dec., 1912 ...	1st April, 1911.
,, ,, ...	D. S. Richards	*480–15–540	,, ,, ...	27th May, 1904 ...	1st April, 1911.
,, ,, ...	H. J. Mackenzie	*480–14–540	,, ,, ...	25th June, 1904...	1st April, 1911.
,, ,, ...	N. F. J. Haszard	*480–15–540	,, ,, ...	27th August, 1906	1st April, 1911.

Office.	Name.	Salary. £	Allowances.	Date of First Appointment.	Date of Present Rank.
	FEDERATED MALAY STATES—*continued.*				
Assistant Superintendent ...	J. W. Johnston	*480–15–540	(*a*) £100 p.a.	10th Oct., 1906 ...	1st Jan., 1912.
Office Assistant Superintendents.	F. A. Sugden	*360–15–480	(*a*) £75 p.a.	10th May, 1901 ...	1st Jan., 1910.
" " "	R. G. Gillett	*360–15–480	" "	17th August, 1903	1st Jan., 1910.
" " "	W. H. Hanson	*360–15–480	" "	11th Nov., 1904 ...	1st Jan., 1911.
" " "	J. T. Wood	*360–15–480	" "	30th Jan., 1909 ...	1st April, 1909.
" " "	A. B. Allen	*360–15–480	" "	9th Oct., 1911 ...	9th Oct., 1911.
Surveyors (I)	O. E. Jansz	*360–15–480	" "	1st May, 1892 ...	1st July, 1903.
"	E. C. Dew	*360–15–480	" "	7th March, 1901 ...	7th March, 1901.
"	R. R. Goulding	*360–15–480	" "	27th June, 1907 ...	27th June, 1907.
"	W. A. Gummer	*360–15–480	" "	1st Nov., 1907 ...	1st Nov., 1907.
"	A. Cochrane	*360–15–480	" "	30th Nov., 1907 ...	30th Nov., 1907.
"	A. P. Schreiber	*360–15–480	" "	3rd Jan., 1908 ...	3rd Jan., 1908.
"	R. V. Morris	*360–15–480	" "	22nd Feb., 1908 ...	22nd Feb., 1908.
"	[illegible] J. C. Stevens	*360–15–480	" "	4th June, 1909 ...	4th June, 1909.
"	[illegible]une	*360–15–480	" "	8th June, 1909 ...	8th June, 1909.
"	C. [illegible]. Sewell	*360–15–480	" "	7th Oct., 1908 ...	7th April, 1912.
"	A. J. Darby	*360–15–480	" "	1st May, 1912 ...	1st May, 1912.
"	Vacant (8)	*360–15–480	" "	—	—
Surveyors (II)	H. L. Penfold	*300–10–360	(*a*) £60 p.a.	28th Jan., 1911 ...	8th April, 1912.
"	H. C. Abraham	*300–10–360	" "	28th Jan., 1911 ...	8th April, 1912.
"	L. M. Davenport	*300–10–360	" "	28th Jan., 1911 ...	8th April, 1912.
"	C. A. Rust	*300–10–360	" "	19th Nov., 1910 ...	8th April, 1912.
"	F. R. Whitton	*300–10–360	" "	22nd Sept., 1911 ...	19th Oct., 1912.
"	C. S. Durst	*300–10–360	" "	23rd Sept., 1911 ...	27th Oct., 1912.
"	Vacant (5)	*300–10–360	" "	—	—
Surveyor Probationers ...	C. S. Wood	*275	Free quarters	8th Sept., 1911 ...	8th Sept., 1911.
" " ...	C. St. L. Perfect	*275	" "	4th Nov., 1911 ...	4th Nov., 1911.
" " ...	H. R. Cholmeley	*275	" "	29th June, 1912 ...	29th June, 1912.

,, ,, ...	R. A. Stubington	*275	,, ,, ...	29th June, 1912...	29th June, 1912.
,, ,, ...	C. E. Nugent	*275	,, ,, ...	19th Oct., 1912 ...	19th Oct., 1912.
,, ,, ...	W. H. Stubington	*275	,, ,, ...	17th Oct., 1912 ...	19th Oct., 1912.
,, ,, ...	Vacant (3)	*275	,, ,, ...	—	—
Surveyors on Agreement ...	N. W. Jarvis	420	(a) £75 p.a.	9th August, 1910	9th August, 1910.
,, ,, ...	A. C. Every	420	,, ,, ...	9th August, 1910	9th August, 1910.
,, ,, ...	H. J. Twamley	420	,, ,, ...	6th Sept., 1910 ...	6th Sept., 1910.
,, ,, ...	A. Du T. Joubert	420	,, ,, ...	7th Sept., 1910 ...	7th Sept., 1910.
,, ,, ...	J. C. Wood	420	,, ,, ...	8th Feb., 1911 ...	8th Feb., 1911.
,, ,, ...	W. Whittingdale	420	,, ,, ...	8th Feb., 1911 ...	8th Feb., 1911.
,, ,, ...	J. Renton	420	,, ,, ...	29th March, 1911	29th March, 1911.
,, ,, ...	W. A. D. Edwardes	420	,, ,, ...	10th April, 1911...	10th April, 1911.
,, ,, ...	J. A. Simpson	420	,, ,, ...	9th May, 1911 ...	9th May, 1911.
,, ,, ...	E. W. Matthews	420	,, ,, ...	8th May, 1911 ...	8th May, 1912.
,, ,, ...	R. C. Crossland...	420	,, ,, ...	8th May, 1912 ...	8th May, 1912.
,, ,, ...	J. T. Hockin	420	,, ,, ...	20th May, 1912 ...	20th May, 1912.
,, ,, ...	W. T. S. Deacon	400	(a) £70 p.a.	3rd April, 1911 ...	3rd April, 1911.
,, ,, ...	R. M. Carson	400	,, ,, ...	3rd April, 1911 ...	3rd April, 1911.
,, ,, ...	E. A. Kenny	400	,, ,, ...	3rd April, 1911 ...	3rd April, 1911.
,, ,, ...	J. W. Stack	400	,, ,, ...	3rd April, 1911 ...	3rd April, 1911.
,, ,, ...	G. W. Allom	400	(a) £40 p.a.	3rd June, 1912 ...	3rd June, 1912.
,, ,, ...	F. H. Frodsham	400	,, ,, ...	3rd June, 1912 ...	3rd June, 1912.
,, ,, ...	F. M. Battye	360	(a) £60 p.a.	4th Feb.. 1911 ...	4th Feb., 1911.
,, ,, ...	F. N. Bridges	300	,, ,, ...	19th Sept., 1912...	19th Sept., 1912.

NOTES.—(i) After four years on the maximum pay of £540 per annum, an Assistant Superintendent may, if specially recommended by the Surveyor-General, draw £555 per annum, and rise by annual increments of £15 to £600 per annum.

(ii) After three years on the maximum pay of £ per annum, an Office Assistant Superintendent may, if specially recommended by the Surveyor-General, draw £500 per annum, and rise by annual increments of £20 to £540 per annum.

(iii) Duty allowance is paid only when the officer is actually on duty in the Malay Peninsula.

(iv) Field allowances: Officers drawing £600 or upwards $5 a night.
,, ,, 300 or under £600 $4 ,,
,, ,, less than 300 ... ... $3 ,,
Camp allowances: All Officers (in addition to F.A.) ... $2 ,,

N.B.—All transport expenses are paid by Government and tents provided.

Office.	Name.	Salary. £	Allowances.	Date of First Appointment.	Date of Present Rank.
		TRINIDAD.			
Engineer-in-Charge of Surveys.	*Mr. E. R. Smart	500	(*c*) Under Ordinance ...	1st April, 1901 ...	1st June, 1910.
First Assistant	*Mr. J. W. Dumanoire	350	" " ..	5th Jan., 1902 ...	16th Jan., 1913.
Second Assistant	*Mr. J. G. Reece	250	" " ...	1st April, 1904 ...	23rd Jan., 1913.
First Draughtsman	*Mr. T. Sorzano	225	(*d*) £75 p.a.	18th July, 1874 ...	1st Jan., 1885.
Second Draughtsman ...	*Mr. Thomas Sorzano	150	... ...	12th Nov., 1881...	12th Nov., 1881.
Third Draughtsman... ...	*Mr. F. M. Sorzano	125	... ...	16th Nov., 1899...	1st April, 1907.
Fourth Draughtsman ...	*Mr. P. N. Dumanoire	75–100	... ...	1st August, 1910.	1st August, 1910.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
745	Trinidad and Tobago	1911–1912
746	British Guiana	"
747	St. Vincent	"
748	Barbados	"
749	Leeward Islands	"
750	Straits Settlements	1911
751	East Africa Protectorate	1911–1912
752	St. Lucia	"
753	Gilbert and Ellice Islands	1911
754	Cayman Islands (Jamaica)	1911–1912
755	Gibraltar	1912
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757	Weihaiwei	"
758	Ceylon	1911–1912
759	Sierra Leone	1912
760	Seychelles	"
761	Somaliland	1912–1913
762	Hong Kong...	1912
763	Turks and Caicos Islands	"
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765	Northern Territories of the Gold Coast	"
766	Bahamas	"
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770	Gold Coast	1912
771	Ashanti	"
772	Nyasaland	1912–1913
773	Bechuanaland Protectorate	"
774	British Solomon Islands	"

MISCELLANEOUS.

No.	Colony, &c.	Subject.
75	West Indies	Imperial Department of Agriculture.
76	Southern Nigeria	Mineral Survey, 1907–8.
77	St. Vincent	Roads and Land Settlement Fund.
78	Weihaiwei	Census, 1911.
79	Northern Nigeria	Mineral Surveys, 1907–8 and 1908–9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments, &c.
85	Southern Nigeria	Mineral Survey, 1911.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S
STATIONERY OFFICE
By DARLING AND SON, LTD., BACON STREET, E.

1913.

COLONIAL REPORTS—ANNUAL.

No. 828.

THE SURVEYS

OF

BRITISH AFRICA, BRITISH HONDURAS, CEYLON, CYPRUS, FIJI, HONG KONG, JAMAICA, MALAY STATES AND TRINIDAD

THE ANNUAL REPORT OF THE COLONIAL SURVEY COMMITTEE.

NINTH YEAR.

To 31st March, 1914.

(For Report for 1912–13 see No. 775.)

Presented to both Houses of Parliament by Command of His Majesty.
February, 1915.

LONDON:
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BY BARCLAY AND FRY, LTD., THE GROVE, SOUTHWARK STREET, S.E.

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T. FISHER UNWIN, LONDON, W.C.

1915.

[Cd. 7622–19] *Price* 2½*d.*

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No. 828.

COLONIAL SURVEY COMMITTEE REPORT.

FOR THE YEAR ENDING 31st MARCH, 1914.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

Owing to the outbreak of war, it has been necessary to omit many of the usual features of the Report, which has been confined mainly to an account of the work carried out by the various survey departments during the year under review.

One of the Secretaries, Captain Cox, is with the Expeditionary Force, and is unable to sign the Report.

H. J. READ,
C. F. CLOSE, *Colonel, D.G.O.S.*
W. C. HEDLEY, *Col., Gen. Staff.*

W. C. BOTTOMLEY, } *Secretaries.*

30th January, 1915.

(C105) Wt.36076/850. 1125 & 90. 2.15. B.&F.Ltd. Gp. 11/2.

I.

REGULATIONS AFFECTING SURVEY DEPARTMENTS.

Memorandum on Colonial Survey Appointments.*

Note.—These regulations supersede those contained in the last report and are subject to revision from time to time.

The Secretary of State for the Colonies has approved of the following arrangements for the selection of candidates for junior survey appointments in Crown Colonies and Protectorates.

1. For the purpose of selecting surveyors, Ceylon, the Federated Malay States, and the East Africa† and Uganda Protectorates will be grouped, and candidates will be required to pass the same tests and go through the same preliminary training. Candidates will, however, be allowed to indicate their preference for particular Colonies, and, if they wish it, to await the occurrence of vacancies. It is possible‡ that other Colonies or Protectorates may be included in these arrangements in the future, but for the present they will apply only to the countries named, which are those in which vacancies may be expected to occur most frequently.

2. Candidates must be between the ages of 21 and 27 and should be unmarried, as the conditions of service for surveyors in the countries concerned are not suitable for a married man.

3. Anyone wishing to become a candidate for these posts should apply in writing to the Private Secretary to the Secretary of State, Colonial Office, London, S.W. He will be required to fill in a form of application and to furnish testimonials and the names of two referees. If the information thus obtained is considered satisfactory, he will be asked to call at the Colonial Office for a personal interview, and, if accepted, will be nominated as a candidate.

4. A candidate not exempted under paragraphs 5 or 6 of this Memorandum will be required to pass two tests :—

(*a*) A qualifying examination in mathematics, including algebra, geometry, and plane trigonometry ; and

(*b*) An oral qualifying examination in the use and adjustment of surveying instruments.

The candidate will be required to pay a fee of one guinea for each examination.

5. A candidate who has passed with honours in mathematics, physical science, or engineering, or who has obtained an equivalent diploma or distinction in a University or School of a University in the United Kingdom, or who has been licensed to practise as a surveyor in one of His Majesty's Dominions, or has obtained the surveying diploma of the Royal Geographical Society, will not be required to undergo any technical or educational test.

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* The selection of candidates on these conditions is suspended during the war

† The extent to which the arrangements can be applied to the East Africa Protectorate is at present uncertain.

‡ The extension of the arrangements to Nigeria has been approved, but no definite information of the conditions which will apply in that case can yet be issued.

6. A candidate who has passed the examination for the Associated Membership of the Institute of Civil Engineers, or the Intermediate or Final examination of the Surveyors' Institution, or the examination of the Institution of Municipal and County Engineers, or has obtained the diploma of the Cambridge University Department of Geography, will be exempt from the technical test referred to in paragraph 4 (*b*) above.

7. Candidates who have passed the qualifying tests or have been exempted will then be required to undergo a medical examination by one of the medical advisers to the Colonial Office in London, Liverpool, Edinburgh, or Dublin. A fee of one guinea will be charged for this examination.

8. According to the number of vacancies, candidates will then be sent to the Ordnance Survey Office, Southampton, for a course of instruction not exceeding two months. If reported on favourably by the Director-General of the Ordnance Survey, but not otherwise, a candidate will become a Survey Probationer and will be granted the amount of his actual railway fares* incurred in connexion with the course, and a lodging allowance of 2*s.* 6*d.* a day and a subsistence allowance of 5*s.* a day for each day spent at Southampton. No travelling expenses other than first class railway fares will be admitted, and return tickets must be taken when any saving would be effected thereby.

9. If the number of candidates reported on favourably by the Director-General of the Ordnance Survey is in excess of the number of vacancies then in existence, the selection of those Probationers first to be sent out will be at the discretion of the Secretary of State. The remainder will be placed on a waiting list pending the occurrence of vacancies. No salary or allowance can be issued during the period of waiting, but a Probationer on the waiting list will have priority over all candidates for Probationerships who attend a subsequent course of instruction unless for any reason he desires his allocation to a particular Colony or Protectorate to be deferred. In the latter event he will be allowed to remain on the list for a further period not exceeding twelve months.

10. A Survey Probationer on being sent out to the Colony or Protectorate to which he is posted will be provided with a free passage on his signing an agreement to refund its cost in the event of his leaving the service of the Government during the period of probation or, in the event of his services being retained, within three years of the date of his arrival, for any reason other than physical or mental infirmity. Passages booked by mail steamer to Ceylon or the Federated Malay States are second class, but in all other cases first class passages are provided. He will draw half pay on the voyage out, and will not begin to draw full pay until his arrival in the Colony or Protectorate.

The salaries and allowances paid to Probationers are as follows :—

Ceylon.—£250 per annum with house allowance of £50 per annum, and when travelling on duty, the usual travelling and personal allowances specified from time to time by the General Orders of Ceylon, which may be consulted in the Colonial Office Library.

Federated Malay States.—£275 per annum with free quarters. Field allowance $3 and camp allowance $2 a night.

Uganda.—£250 per annum, with free quarters or an allowance at the rate of 10 per cent. of salary when at a recognised station.

* Travelling expenses are not granted in respect of the candidate's call at the Colonial Office or his qualifying or medical examinations.

11. At the end of one year he will, if approved by the Surveyor-General or Director of Surveys, be appointed to the Department at the ordinary rate of pay attached to the appointments of Assistant Superintendent of Surveys, Second Grade Surveyor, or Junior Staff Surveyor, as the case may be. The appointment will in the first instance be for three years in the case of Ceylon, and for 30 months' service and the leave incidental thereto in the case of Uganda, with a prospect in each case of re-engagement if the Surveyor's service continues to be satisfactory. In the Federated Malay States a Surveyor may be placed on the pensionable establishment at the end of his probation, provided that he has then obtained the language qualification. In Ceylon, also, a Surveyor has a prospect of ultimate appointment to the permanent establishment, while in Uganda nine, and in East Africa only two, of the appointments in the Survey Department are permanent and pensionable.

12. Information as to the emoluments of the posts mentioned in paragraph 11 and of senior appointments is included in Appendix III. to this pamphlet.

13. If at the end of a year's probation a Probationer is not approved, his appointment will be terminated, and he will have no claim to any compensation beyond a free passage back to England. The probationary period of one year may, however, be extended at the discretion of the Governor or High Commissioner if the extension is recommended by the Surveyor-General or Director of Surveys on account of special circumstances.

14. The Secretary of State does not by these arrangements preclude himself from considering an application for appointment from a Surveyor who is fully qualified in the practice of his profession but whose case cannot be dealt with under the ordinary procedure for filling Survey Probationerships.

Appendix I.

*Syllabus of Examinations.**

The qualifying examination in Mathematics referred to in paragraph 4 (*a*) will be conducted in accordance with the following syllabus :—

Algebra ..	.. Up to quadratic equations and problems involving their solution. The use of logarithms of numbers and problems (*e.g.*, in Interest and Annuities) involving them. Construction of graphs for the comparison of thermometric scales. British and foreign measures, &c. Graphical solution of problems dealing with corresponding values of two variables.
Geometry ..	.. Theoretical and practical Geometry.
Mensuration	.. Construction of scales (equal parts, diagonal, vernier, &c.). Questions connected with the scale of maps. Rectification of crooked boundaries. Equal area problems. Calculation of areas from various data (*e.g.*, areas of triangle from lengths of sides, of plot of land from rectangular co-ordinates, of sectors of circles, lunes, and curvilinear areas, &c.).

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* Intending candidates who have no previous knowledge of surveying and do not desire to arrange for special tuition will find useful information in the "Text-book of Topographical Surveying" (revised edition), by Colonel C. F. Close, C.M.G., R.E., published by the War Office.

Plane Trigonometry Up to the solution of triangles, with applications to heights and distances. The use of trigonometrical and logarithmic tables.

†Practical questions under the following heads:—
(*a*) Base measurements and determination of heights.
(*b*) Solutions of triangles.
(*c*) Traverses and co-ordinates.
(*d*) Satellite stations and adjustment problems.
(*e*) Inaccessibility problems.

Three papers will be set: (I) in algebra, (II) in geometry and mensuration, and (III) in plane trigonometry. Three hours will be allowed for each paper.

The questions in each paper will be arranged with a view to testing the candidates' ability and accuracy in arithmetical work.

One hundred marks will be allotted to each paper.

Candidates will be required to obtain 55 marks in each paper. In the geometry and mensuration paper four questions (of which three only are to be attempted) will be set on geometry and nine (of which seven only are to be attempted) on mensuration. 40 marks must be obtained on the second section. In trigonometry ten questions (which will be marked equally) will be set, five of a general character and five under the heads marked † above. 35 marks must be obtained on the second section alone.

A set of specimen questions is included in Appendix II.

The qualifying examination in the use of instruments will cover the transit theodolite (vernier or micrometer microscope), level (Cooke's or dumpy), chains, tape, plane table, Indian clinometer, trough compass, prismatic compass, and aneroid barometer. Candidates will be expected to have a general knowledge of the use of these instruments and to be able to set them up and adjust them.

It is to be understood that, while the examination is not competitive in the sense that the candidate who stands highest on the list will have any claim to priority of consideration, the marks obtained will be taken into account by the Secretary of State in comparing the merits of the various qualified candidates.

Appendices II and III, not reprinted, will be found in the memorandum (Miscellaneous No. 225) relating to these appointments. It can be obtained on application to the Private Secretary to the Secretary of State, Colonial Office, S.W.

II.

REPORTS ON THE SURVEYS OF BRITISH AFRICA.

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EAST AFRICA PROTECTORATE.

Governor	Sir H. Conway Belfield, K.C.M.G.
Director of Surveys	Captain G. C. Williams, R.E.
Deputy Director of Surveys, Trigonometrical and Topographical Branch.	Captain A. M. Coode, R.E.
Deputy Director of Surveys, Cadastral Branch.	Mr. A. E. Townsend.
Assistant Directors of Surveys, Trigonometrical and Topographical Branch.	Captain H. N. Kempthorne. Lieut. G. A. P. Maxwell, R.E.
Assistant Director of Surveys, Cadastral Branch.	Mr. T. H. Galbraith.

Organization of the Survey Department.

Field.

Trigonometrical and Topographical Branch	Deputy Director. 2 Assistant Directors. 6 European surveyors (N.C.O.'s, R.E.).
Cadastral Branch	1 Assistant Director. 26 European surveyors. 3 Indian surveyors. 2 native surveyors.

Office.

Superintending Staff	1 Director. 1 Office Superintendent. 1 European clerk.
Cadastral Branch	Deputy Director (sometimes in field). 4 European clerks. 1 Goanese clerk 7 European computers. 7 European draughtsmen. 1 Indian photographer. 5 Indian tracers.

There are also 17 licensed surveyors in the country who, although not on the staff of the Department, undertake some of the farm surveys

The Work of the Past Year.

Trigonometrical and Topographical Branch—Capt. Coode did not complete the work of the Mahagi boundary until 30th June; and Capt. Kempthorne was on leave from the 2nd of November.

Trigonometrical Work.—The total area covered by major and minor triangulation during the year amounted to 7,823 and 2,360 square miles respectively.

It will be seen from Table I below that the average triangular errors show a distinct improvement on last year. The errors in the Lake and Coast triangulations are large compared with those in the Highlands, but are still within desirable limits.

Major and minor triangulation was completed during the year over the following areas:—

(i) Western half of North Kavirondo.
(ii) Small area to complete Uasin Gishu work.
(iii) North Kenya.
(iv) Coast Belt from Malindi to Tana River.
(v) Country between Railway and Anglo-German boundary from Lake to Rift Valley.

The cost of triangulation was 7·2 shillings per square mile.

Table I.

Comparative Annual Statement of Triangulation.

Year ending March 31st.	Major Triangles.			Minor Triangles.		
	No.	Average triangular error.	Area.	No.	Average triangular error.	Area.
		Seconds	Sq. miles		Seconds	Sq. miles
1908	50	1·77	7,320	163	2·51	3,610
1909	27	1·11	5,624	8	1·66	600
1910	34	1·45	738	20	2·68	1,117
1911	38	1·59	4,821	75	3·02	4,239
1912	18	1·06	2,629	23	3·1	3,615
1913	55	2·72	8,209	26	3·72	1,323
1914	63	2·16	7,823	39	2·79	2,360

Topography.—The plane tables were employed on the topographical survey of 950 square miles of farm land on scale $\frac{1}{12500}$ in North Kenya. A provisional map on the same scale was made of the coast strip from Malindi to Kipini and Witu. Also the following sheets have been surveyed on scale $\frac{1}{25000}$:—

		Sheet.	
Western half	..	N.A.36 W	(Mumia's)
Whole	..	S.A.36 E	(Kisumu-Kisii)
Three-quarters	..	S.A.37 B	(Kenya)

The results of the topographical work are most satisfactory. The maps are thoroughly good and reliable, and a rapid state of progress has been maintained. The average rate of work on scale $\frac{1}{12500}$ has been 6·6 square miles per day, and on scale $\frac{1}{25000}$ it has been 9·5 square miles per day.

Drawing and Compilation.—The following sheets have been sent to England during the year for printing:—

$\frac{1}{25000}$ series .. .. { S.A.37 H (Machako's); N.A.36 W (Mumia's) }

$\frac{1}{100000}$ provisional series { North A.37; South A.37 }

The first two sheets are final.

The $\frac{1}{12500}$ maps of the North Kenya District and coast strip Tana River have been reproduced locally.

Table II.

Comparative Annual Statement of Topography.

Year ending 31st March.	Scale.		
	$\frac{1}{6336}$	$\frac{1}{12500}$	$\frac{1}{25000}$
	sq. miles.	sq. miles.	sq. miles.
1908	447	—	(reconnaissance)
1909	973	—	—
1910	450	3,342	—
1911	688	2,987	8,575 (4,900 reconnaissance)
1912	—	2,060	5,390 500 reconnaissance)
1913	—	1,188	10,500 (1,000 reconnaissance)
1914	—	1,680	8,000

Cadastral Branch.—The health of the staff has, on the whole, been good; though the surveyors while employed on the coast have suffered from a good deal of fever.

The arrears on 1st April, 1913, were 1,790,608 acres. These arrears were reduced in October to 982,610 acres. In November instructions were received for the survey of farms on Laikipia and North Kenya. This increased the arrears to 2,550,448 acres. At the close of the year the arrears had been reduced to 2,456,475 acres. From this it will be seen that the Survey Staff are capable of dealing with the normal amount of new work ordered, and are able to overtake arrears slowly. It is not expected that other large areas will be opened for settlement in the future, as most of the land available for white occupation is now being dealt with. Under these conditions it will take the Staff some years to reduce the arrears to manageable proportions.

The cost per acre of cadastral surveys is 6·06*d*., as compared with 4·51*d*. last year and 5·96*d*. the year before.

Surveyors.—The standard of work has been well maintained and is satisfactory. Surveys during the year have been scattered over the Protectorate. The large blocks surveyed were the Ithanga, Sapuk, and Eburu allotments, Lukenya and Kiu farms, Nyeri extensions, Kibigori-Muhoroni block, Kaimori coffee lands, Mbagathi dairy farms, completion of Trans-Nzoia and Uasin Gishu allotments, re-surveys in Kikuyu, Limoru, and Kinangop Districts, Malindi coast surveys and Mombasa Island surveys.

The development of the country has increased the demand for township and subdivisional surveys. A great deal of the surveyors' time is being taken up with this work, which is slow and laborious.

The coast lands surveys are making steady progress. On Mombasa Island all the shambas have been demarcated and are being finally surveyed, and the work is now being carried into the native town.

The Malindi surveys have continued without interruption, and the survey of the Mazrui Reserves has been completed. Demarcation has been started on the Tana River near Kipini, and on the coast belt south of Mombasa

Seven qualified surveyors took out licences during the year.

Computers.—The general work of the staff has, on the whole, shown great improvement during the year.

The staff for the year has consisted of a chief computer and 6 computers, being three more than last year.

During the year licensed surveyors have increased their practice very largely, and are now employing many more assistants; so that their output is becoming out of all proportion to their actual numbers. Further, the surveys of private subdivisions have to be checked for registration purposes. Consequently the work of the staff has fallen into arrear. During the year, 2,000 areas were received for checking, but only 1,290 were checked. To relieve this congestion two surveyors were transferred temporarily from the field to the computing office.

Drawing Office.—The output of plans exceeds that of any previous year.

The work of preparing the new 15 minute $\frac{1}{63360}$ Cadastral sheets has been progressing slowly. This series will form a complete record of all survey data. 106 sheets have been plotted in skeleton during the last two years. This leaves a further 20 sheets to be dealt with, when the whole of the settled districts will be covered. The completion of this series of farm sheets is of first importance, as an excellent framework will thus be formed for the rapid production of maps on a reduced and more serviceable scale; moreover, the Meridional District System and Card Index Scheme are based on these sheets.

A time and labour-saving device which has been adopted with success is that of utilizing extracts from lithographs, specially prepared on parchment papers, of general allotments, as deed and licence plans and township deed plans.

TABLE III.

DETAILS OF CADASTRAL SURVEYS FOR YEAR ENDING 31ST MARCH, 1914.

Description	Number	Acres
Agricultural and Grazing Farms and Mining Concessions	509	1,180,676
Reserves	33	15,789
Re-Surveys	145	96,859
Township Plots	481	423
Road Surveys	14	262
Forest Surveys	3	89,396
Township Contour Surveys	6	1,663
Check Surveys	3	5,626
Private sub-division of farms into smaller plots ..	144	177,071
Private sub-division of Township plots and sub-division of Township plots	271	1,291
Coast Land Surveys, Malindi shambas	238	10,440
Coast Land Surveys, Reserves	6	17,701
Coast Land Surveys, Mombasa Island	55	554
Coast Land Surveys, Demarcations	137	10,562
Total ..	2,045	1,608,313

NOTE.—These figures are exclusive of Miscellaneous surveys shewn below :—

Nature.	Area.
Triangulation	1,240,095 acres.
Plane table surveys (4)	820 ,,
Incidental traverses	15,248 ft.
Inspection and sundry surveys ..	10

TABLE IV.

COMPARATIVE ANNUAL STATEMENT OF CADASTRAL SURVEYS.

Year ending March 31st.	Surveys finished.		Surveys ordered but not finished.
	Number.	Acres.	Acres.
1909	294	1,161,583	350,000
1910	268	553,261	813,000
1911	482	484,266	1,519,930
1912	1,034	690,995	1,606,797
1913	976	1,082,069	1,790,608
1914	2,045	1,608,313	2,456,475

COST.

Expenditure and Revenue.—Table V gives a comparative annual statement.

TABLE V.

Year ending March 31st.	Trigonometrical and Topographical Branch.		Cadastral Branch.		Revenue.
	Estimated.	Spent.	Estimated.	Spent.	
	£	£	£	£	£
1909 ..	8,416	6,427	13,049	13,177	860
1910 ..	8,029	8,571	13,064	13,181	1,495
1911 ..	8,797	7,246	12,739	13,460	4,727
1912 ..	8,546	6,790	16,260	14,965	5,280
1913 ..	8,735	8,075	22,065	21,667	1,108
1914 ..	8,291	7,868	24,105	24,873	4,922*

*Details of Revenue 1914.

Survey fees	£4,739
Sale of maps	164
Sale of War Office maps	19
	£4,922

Cost of different classes of Survey.—Table VI gives a comparative annual statement.

TABLE VI.

COMPARATIVE ANNUAL STATEMENT OF COST OF SURVEY.

Year ending March 31st.	Triangulation, Shillings per sq. mile.	Topography, Shillings per sq. mile.	Cadastral Survey Pence per acre.
1909	11·6	—	3·73
1910	14·6	18·2	5·81
1911	8·6	6·5	5·31
1912	19·4	11·0	5·96
1913	6·6	8·0	4·51
1914	7·2	10·4	6·06

GOLD COAST.

Governor	Sir H. C. CLIFFORD, K.C.M.G.
Director of Surveys	Capt. H. A. L. HALL, R.E.
Deputy Director of Surveys ..	Capt. P. J. MACKESY, R.E.
Assistant Directors of Surveys ..	Lieut. W. F. R. KYNGDON, R.A.
	Lieut. C. L. T. MATHESON, R.E

ORGANISATION OF THE SURVEY DEPARTMENT.

Headquarters	Director of Surveys. Clerk. Draughtsman.
Trigonometrical and Topographical Branch ..	Deputy Director of Surveys. 2 Assistant Directors of Surveys. 6 European surveyors (N.C.O's., R.E.). 1 European draughtsman.
Cadastral Branch	Chief surveyor } N.C.O's., R.E. 2 Senior surveyors } or ex- 2 Surveyors } N.C.O's., R.E. 5 Native surveyors. 2 Native draughtsmen.

In addition a large number of educated natives capable of compass chaining is employed. Some of these men are capable of independent work and of becoming properly qualified surveyors.

THE WORK OF THE PAST YEAR.

Trigonometrical and Topographical Branch.

The health of the staff has been far from good. Over a period when health was at its best and when accurate records were kept one day's sickness in 10 was recorded. This, however, did not include periods when men were ill previous to invaliding. Lance-corporal O'Connell

was invalided in May. The staff in the Northern Territories, which had previously been reduced to two-thirds, was thus still further reduced to half. An increase had however previously taken place by the arrival of Lance-corporal Grandy. He was, for his first six weeks, three of which he was sick, kept at Accra for instruction. Since then the health of this N.C.O. has been good.

During the year the staff was increased by the addition of a draughtsman. An additional officer was sanctioned and Lieutenant Kyngdon arrived in November.

Triangulation.—Triangulation is to be carried out over the Navarro and Gambaga Sheets during the ensuing rains. The erection of beacons was in progress at the end of March. Continuous work, however, is difficult at this time, as the harmattan returns for a few days at a time and sometimes continues to do so till as late as May.

Topography.—The methods employed are described in the report for the year 1913.

By March 31st, 10,583 square miles had been completed—4,634 square miles were completed on March 31st, 1913, so that the figur for the year under review is 5,949. The average per man per day is 7 square miles. The average for actual detail work has been 12 square miles, and excluding days sick 13 square miles. The average cost overall is rather under £1 a square mile, and for detail only has averaged 2*s.* 9*d.* a square mile. Approximately one mile of traverse is required per square mile except where trackless wastes, which are not surveyed, exist. Wheel traverses have averaged 7·7 miles per day. This increases to 10 miles with experience. The cost has been 5*s.* 2*d.* per mile. This class of traverse entails approximately an extra 50 per cent. of walking.

Between April 1st, 1913 and March 31st, 1914, the following work was finished:—

Rigid traverses	225·6 miles.
Chain and compass traverses ..	200 „
Levels	161 „
Topographically surveyed	5,949 square miles.

Northern Ashanti. A rigid traverse was run from Coomassie to Prang. The total distance covered was 122 miles; the rate per diem was 1·5 miles, and the cost per mile £3·26. This traverse helps to fix the longitude for the Northern Territories which, until its completion, was based on the subtense traverse of the Volta. This longitude cannot, however, be taken as final, as further theodolite traverses are still required in Ashanti. Provisional sheets have been sent to England for reproduction.

Colony. Sufficient work had been done on the Afram and Wupe sheets to enable provisional sheets to be produced.

Cadastral Branch.

There has been considerable sickness amongst the staff and two men were invalided after 7 and 4½ months' service respectively.

Concession Surveys. Of the two concessions marked down for early survey on December 31st, Adakaba Pattison's has been completed and Ntubia was in hand on March 31st. This latter concession requires a traverse of 50 miles to tie it to the Colony survey.

Concessions which have been received for office check only since December 31st have all been completed. The area actually surveyed by the Department since January 1st, 1913, has been 31,968 acres.

Town Surveys. These are all on the scale of 1 in 1,000. Obuasi and Axim are to be reproduced. Obuasi consists of nine sheets and was completed by two European surveyors in two months. Considerable assistance was obtained from the surveys made by the Ashanti Gold Fields Corporation. Axim consists of 16 sheets and was completed in three and a-half months. For six weeks two European surveyors only were available, for the remaining two months three men were employed.

Sheets measure 24 inches by 24 inches.

At the beginning of 1914, town planning was handed over to the Survey Department, and some work has been done in this connection at Komfrodua, Nyakrom, Swedru, Kwanyako, Nsaba, and Seccondee.

In the smaller towns too detailed surveys are not necessary. Mud huts rapidly grow up and others disappear. A committee of Heads of Departments concerned has been formed to enquire into the types of survey required.

Special Work.

At the close of the year the surveys of two native boundaries in dispute were in hand. Natives are most exasperating in that there is the greatest difficulty in obtaining their presence as witnesses, with the consequence that much of the surveyors' time has been wasted. In future it is hoped to prevent this by enforcing the Survey Ordinance, which hitherto has never been used.

Maps.

Map of the Colony ($\frac{1}{125000}$). The Afram and Wupe sheets were roughly surveyed during the year and sent home for production as provisional sheets.

Map of Northern Ashanti ($\frac{1}{250000}$). Provisional sheets covering the whole area between the 7th and 8th parallels were sent home for production.

Map of the Northern Territories ($\frac{1}{250000}$). The production of the Salaga and Tamale sheets was delayed owing to the invaliding of one surveyor and to delays caused by floods. The final portion required

for the Salaga sheet was completed before the close of the year, and also that of the Tamale sheet in so far as field work only was concerned.

Cost.

The cost of the Department was £14,582.
The revenue for the year was £2,635 17s. 4d.
The following is a statement of proportional cost:—

	Per cent.
Salaries and allowances	51
Carriers	33
Stores	4
Passages and railway expenses	5
Miscellaneous	7
	100

Geological Survey.

Director .. .. Mr. A. E. Kitson F.G.S.
Assistant Director .. Mr. B. N. K. Wyllie F.G.S.

Field Work.—During the season 1913–14 a preliminary examination was made of the districts round Accra, Dodowa, and Somanya (including visits to Osudoku and Kpong), and of the railway line to Komfrodua. The route then taken was Asafo—Kokorantumi—Kwahu Plateau—Juaso—Odumasi—Lake Bosumtwe—Coomassie. After a short trip to Ejura the Survey Party marched near the railway line to Seccondee. The Director then examined the coast from Winneba to Accra. The total distance travelled was about 1,900 miles and several hundred miles were also traversed by parties of labourers.

Laboratory Work.—Specimens have been examined chemically and microscopically, and a large number of economic interest are under investigation at the Imperial Institute.

NIGERIA.

Governor-General	Sir F. J. D. Lugard, G.C.M.G., C.B., D.S.O.
Surveyor-General	Major F. G. Guggisberg, R.E., C.M.G.
Officer in charge of Special Mine-fields Survey	Captain F. L. N. Giles, R.E.

SOUTHERN PROVINCES.

Deputy Director of Surveys ..	Mr. A. Cleminson.
Deputy Director, Topographical Branch	Captain R. H. Rowe, R.A.
Assistant Director, Trigonometrical Section	Lieut. H. I. Bulkeley, R.A.

NORTHERN PROVINCES.

Chief Surveyor .. .. Mr. A. S. COLLARD.

ORGANISATION OF THE TWO NIGERIA SURVEY DEPARTMENTS.

The organisation of neither survey department was affected by the amalgamation of Northern and Southern Nigeria on January 1st, 1914, into the Colony and Protectorate of Nigeria. A Surveyor General was appointed with direct supervisory powers over the Southern Provinces and over a certain area in the Northern Provinces, but the two departments continued to run on their respective lines.

The Southern department and mines survey section were organised as under :—

Surveyor – General's Office and Headquarters, Southern Provinces Survey	Surveyor-General. 1 Office Superintendent. 1 Native map curator. 5 Native clerks.
Cadastral Branch, Southern Provinces	1 Deputy Director. 3 1st grade surveyors. 1 2nd grade surveyor. 1 Draughtsman (N.C.O., R.E.). 1 Surveyor (N.C.O., R.E.). 4 N.C.O.'s, R.E., Special Survey. 3 Native clerks. 7 Native surveyors. 6 Native draughtsmen. 6 Probationers.
Topographical Branch, Southern Provinces	1 Deputy Director (Captain R.A.). 4 Military Officers. 7 N.C.O.'s., R.E. 8 Native surveyors. 3 Native draughtsmen. 6 Probationers.
School, Southern Provinces ..	1 Instructor (N.C.O., R.E.). 7 Pupils.
Mines Survey Section, Northern Provinces	2 Officers, No. 1 Party. 11 N.C.O.'s., R.E., No. 1 Party. 1 Civilian, No. 1 Party. 2 Officers, No. 2 Party. 12 N.C.O.'s., No. 2 Party.

PRESENT STATE OF TOPOGRAPHY AND MAPS IN NIGERIA.

Up to date approximately 25,000 square miles have been topographically surveyed in the Southern Provinces and 4,000 square miles in the Northern Provinces Minefield on the 1 : 62,500 scale, but the latter area requires supplementary survey to attain the full value in detail possessed by the map of the first-named area. Outside the minefield few topographical surveys of any value exist in the

Northern Provinces, except along the international boundaries. With a native staff gradually increasing in experience and numbers the present annual output of the topographical branch (10,000 square miles under normal conditions) should gradually increase to a maximum of from 15,000 to 20,000 square miles.

In the Southern Provinces, Major Beverley's compilations on the 1 : 250,000 and 1 : 500,000 scales are proving useful pending the production of the Standard Map (1 : 125,000). Although necessarily inaccurate, owing to the lack of framework, they are of proportionately greater value than the 1 : 250,000 sheets of the Northern Provinces which, besides suffering from want of framework, seriously need revision by an officer specially charged with that duty, and working under the supervision of the Surveyor-General and in direct collaboration with the topographical branch.

Trigonometrical.—The Trigonometrical Section was employed in constructing the framework of the Protectorate survey between the Niger River and the Cameroons, south of about 6° 45′ N. lat. As the country had previously been untouched, the work included all the processes of triangulation supplemented by theodolite traverses and instrumental levels, and had to be executed with the utmost rapidity to enable the Topographical Section to start work in Octob 1913. At the present moment the work is approaching completion and exact figures are not obtainable, but, in spite of the many difficulties incidental to work in a new country, the section has successfully attained its object. A base (invar) was measured south-west of Udi and about 8,000 miles of reconnaissance, 6,000 miles of triangulation, 176 miles of theodolite traverse, and 240 miles of instrumental levels completed. The number available for the above 12 months' work was: 1 officer, 12 months; 1 officer, 9 months; 4 European surveyors, 8 months; 2 native surveyors, 10 months; and 8 native surveyors (levelling for 2 months).

Topographical.—The fourth field season began in October, 1913, when the Topographical Sections were transferred to the country east of the Niger with the primary object of providing the engineer in charge of the railway survey, with a contoured map of a belt 30 miles wide along the proposed route of the new railway from Port Harcourt via Udi, Abinsi and Jemaa to Kaduna. The above work was combined with the methodical survey of 8½ standard sheets, but, as it was urgently required, was undertaken first. By April, 1914, a map on a scale of 1 : 62,500 with 25-feet contours from the Imo River to 6°30′ N. lat. had been handed over to the railway engineer. The remarks of the railway engineer show that this map enabled him to locate long straights in the more level and palm covered country near Aba, and saved him several months' delay in finding the best general route through the very intricate and heavily wooded country between Bende and Okigwi.

In October, 1914*, the Topographical Section begin a programme with similar objects to those of this field season along the proposed route of the new railway between the Benue River and 10° N. lat., and between 8° and 9° E. long. The Trigonometrical Section will

* These proposals have been modified owing to the outbreak of war.

begin extending the Naraguta triangulation over the above area in June, and will thus form a framework for the Topographical Section as well as for those mine surveys lying outside the minefield and which are executed by the Northern Provinces Survey Department. Programmes for 1915 to 1917 have been sanctioned and will lead to the Naraguta and Udi triangulation, at present in the air, joining the western triangulation at a point east of Ilesha.

Cadastral Branch.

Western Province.—Good progress was made with the detail survey of Lagos. By the 31st March, 1914, 9 of the 88-feet sheets had been published, 19 were in the publisher's hands, and 6 sheets had been nearly completed. The addition of a European draughtsman to the Cadastral Staff resulted in a greatly increased and more methodical output. It is anticipated that the 88-feet sheets will, besides being essential for investigation of titles and tenure, be invaluable in future assessments for water rates and for other municipal purposes, and Mr. Cleminson is to be congratulated on his foresight in adopting the detailed method on which the town is being surveyed.

Numerous other surveys required by the Government were completed.

Central Province.—The Lands Survey Section remained closed down, as no relief was available for Mr. Webb, who, on his return from leave in March, 1913, was employed in Lagos in charge of the Cadastral Branch until September, and afterwards on the Ojuwoye sites until March, 1914.

Eastern Province.—Good progress was made with the Calabar Survey (1 : 1,000) until the Lands Surveyor's departure on leave in March, 1913. On his return in August he undertook the revision survey of the Uwet mining leases, so that little further time was available for the Calabar survey by the time the section was closed down owing to urgent requirements in the neighbourhood of Lagos. Between March and August, a detachment of the Special Cadastral Party, under Lce.-cpl. Godwin, assisted by native surveyors completed an accurate contoured survey of the site now occupied by Port Harcourt and topographical reconnaissance with instrumental levels of the neighbourhood. The work was carried out in very swampy country in the height of the rains. Other surveys were completed at Akassa and Uyo.

Statistics of Cadastral Branch Work.—671 acres of town survey were completed, at a cost of £2 10*s.* 2*d.* per acre; 46,154 acres of country surveys at 7·3*d.* per acre; 1,288 acres of detail survey of Lagos 88-feet sheets at 2*s.* 4*d.* per acre. 698 plans and tracings were made and 11 map compilations.

School.

Ten pupils joined the new class (the fifth since the school started) in October. Four pupils were appointed as surveyors and two probationers as draughtsmen. Seven pupils and six surveyors and draughtsmen were summarily dismissed in February, 1914, for insubordinate conduct and deliberate refusal to continue work in the field. Steps are being taken to fill the vacancies.

Special Work.

The headquarters' office carried out several items of special work during the year, including the supervision of the Minefields survey (specially reported on in para. 27 *et seq.*), drafting schemes for the general organisation of the Kano Revenue Surveys and School, and proposals for the Regulations of the Minerals Proclamation, and compiling 100 plans of Government stations from available information of varying value to assist in marking out proposed reservations pending future Cadastral Surveys. In March, 1914, the Survey Department was charged with the duties of designing and marking out reservations. Up to date there has been only time for one to be completed, but in future these duties will form an important item in the work of the Cadastral Branch.

The Topographical Branch, in addition to the purely topographical work already described, carried out numerous surveys of boundaries, Government Stations, lands held under various titles, forest reserves, etc., lying in the area of the season's programme, besides assisting the political officers in cases of disputed boundaries. The following special plans were supplied:—Seven Forest Reserves (1 : 11,500 to 1 : 62,500, according to area); 11 Government Stations (1 : 4,800); five Towns (1 : 12,500); nine areas held under various titles. During the fourth field season the special map of the railway belt already referred to has been supplied, the special map of the coalfields in the neighbourhood of Udi has been made, and the plans of 10 Government Stations and other miscellaneous Land Surveys are in hand.

Publication of Maps.

Progress has been made with the publication of the topographical sheets of the standard map and of the 88-feet sheets of the Lagos map, eight and nine sheets respectively being published during the year. A town plan of Warri (1 : 4,800) was published and the proofs of a 5-chain map of Lagos Municipal Area corrected. Map publication was considerably accelerated by the Ordnance Survey taking over the production of certain sheets. Upwards of 100 plans were published locally in sun-print form for issue for Government purposes or on repayment.

Cost and Revenue.

The 1913 estimates provided £25,286 for survey recurrent expenditure in the Southern Provinces and £1,550 for the special Lagos survey. The figures for the actual expenditure were £23,607 and £1,818 respectively. As the whole department was employed on Government work, the actual revenue earned by survey fees and sale

of maps did not exceed £400. By the scale of fees applicable to private individuals, the paper revenue earned by land surveys was approximately:—Cadastral Branch, £4,500; Topographical Branch, £3,000.

During the period December 12th to March 14th a total of 487 areas was accounted for by the methods of survey and under the difficult local conditions described in the last report of the Colonial Survey Committee. Numbered survey beacons were left on every mine and were connected to the triangulation. The officers of the party completed 7,500 square miles of triangulation, which included observations and computations for 85 stations, the average probable error being 1 : 15,000 for main stations and 1 : 5,000 for intersected and interpolated points. The thick weather of the harmattan necessitated observations at 30 azimuth stations to supplement the triangulation and enable theodolite traverses of mine boundaries to be run. The triangulation can be readily extended in any direction to form the framework of the Nigeria survey, the bases at Kano and Udi forming check bases, and the absolute geographical co-ordinates becoming available when the Lagos (or Western) triangulation is reached.

Maps and records. One of the most satisfactory points of the work was the complete system of records, both mining and topographical, kept in the mines survey office at Naraguta. Quarter-degree field sheets mounted on zinc on the 1 : 62,500 scale were kept up to date with all surveys executed in the field. Records of the methods of compilation of each sheet, and of the catalogue numbers of all books, plans, traverses and fixed points used, were kept in the "reference book" of each sheet on the system used by the topographical branch. Owing to the pressure of mining work, it was naturally not possible to make these sheets as complete in topographical detail as could be wished, but they can be rapidly completed when experienced topographical native surveyors become available. It is hoped that time will be found to complete many sheets in this manner when the topographical branch are in the neighbourhood at the end of the year. Sufficient material is, however, available for the production of several sheets of the Minefield Map (1 : 62,500) during the next few months, when a sketch map (1 : 250,000) of the minefield will also be published. In view of the constant supply of fresh detail that will be received during tne next 12 months, the publication of both maps will be in a cheap and easily altered form.

The total cost of the work will be about £13,948, which is less than was anticipated. An actual revenue of £4,916 in survey fees has been earned. Had the survey fees provided by the new Minerals Proclamation been in force, the revenue would have exceeded the total cost of the party by £470, figures which are useful in showing that a special party can be self-supporting without charging fees that are in any way exorbitant.

NYASALAND.

Governor	Sir GEORGE SMITH, K.C.M.G.
Director of Public Works ..	Mr. T. I. BINNIE.
Assistant Director of Public Works	Mr. T. F. FIRR.
Surveyor	Mr. D. WALLACE.
Assistant Surveyor	Mr. E. H. HOLMDEN.

THE WORK OF THE PAST YEAR.

FIELD.

Trigonometrical.—A small amount of trigonometrical work has been undertaken by Mr. Firr in connexion with the amended Anglo-Portuguese boundary at the east and south-east of Lake Shirwe.

Topographical.—No work was done.

Cadastral.—The two Assistant Surveyors were engaged on the survey of estates from October, 1913, to February, 1914, inclusive, during which period some 17 estates aggregating some 2,921 acres were surveyed in the Zomba, Blantyre, West Shire, and Lower Shire Districts.

Office Work.—20 plans and 86 tracings have been made.

COST.

The cost of the Department was £968.

UGANDA.

Governor	Sir F. J. JACKSON, K.C.M.G., C.B.
Director of Surveys and Land Officer	Mr. R. C. ALLEN.
Deputy Director of Surveys ..	Mr. L. R. FRASER.
Conveyancer	Mr. F. GUTHRIE SMITH.

ORGANIZATION OF THE SURVEY DEPARTMENT.

Headquarters	Director of Surveys. Deputy Director of Surveys. Conveyancer. 1 European surveyor. 3 European clerks. 1 European draughtsman. 2 Indian clerks. 2 Indian draughtsmen.
Native Estate Surveys in Buganda	10 European surveyors. 1 Indian assistant surveyor.
Crown Lands surveys ..	2 European surveyors.

Compared with the previous year, the staff has been increased by 1 Conveyancer and 1 European clerk. In November, 1912, the Deputy Director of Surveys, Mr. H. Boazman, resigned and Mr. L. R. Fraser was appointed to fill the vacancy.

The Work of the Past Year.

Native Estate Surveys.—This work is done in accordance with the provisions of the Buganda Agreement of 1900.

The area over which theodolite observations, at points about 1 mile apart, were finished was 356 square miles (885 square miles in 1912–13). The *total* area over which points have been fixed is 4,728 square miles.

The area of which the detail was mapped was 663 square miles (704 square miles in 1912–13).

The *total* area surveyed is now 4,650 square miles.

Crown Land Surveys.—Two surveyors were employed on these, including townships. An area of about 23,000 acres has been re-surveyed in Buganda Province in connexion with sales of native land to Europeans and to natives.

Township Surveys.—A considerable amount of survey work has been done during the year at Jinja, Kampala, Namasagali, Bugondo, and Soroti. Small areas have been surveyed at Bukakata and Kibanga (ports on Lake Victoria). The survey of Mjanji Port on Lake Victoria is now in hand. There has been a keen demand for township plots, especially at Kampala.

Land Office.—The number of leases and grants of land during the year, other than grants to natives under the Buganda Agreement of 1900, amounted to 213 (117 in 1912–13, 77 in 1911–12).

Cost.

Expenditure and Review.—The expenditure up to 31st March, 1914, was £9,524 and the revenue £10,460, £6,486 of this being land rents.

Different Classes of Survey.—The cost of *native estate surveys*, excluding the expenditure on headquarters, was £7 16*s.* per square mile (£6 14*s.* in 1912–13), or 3·08*d.* per acre.

The cost of *Crown lands surveys* was roughly £10 per square mile.

III.

THE STATE OF THE SURVEYS

OF

British Honduras, Ceylon, Cyprus, Fiji, Hong Kong, Jamaica, Malay States and Trinidad.

BRITISH HONDURAS.

Governor	Sir W. COLLET, K.C.M.G.
Surveyor General	Mr. H. I. PERKINS, I.S.O.
Assistant Surveyor General ..	Mr. W. H. CARLIN.

ORGANIZATION OF THE SURVEY DEPARTMENT.

Headquarters	Surveyor General Assistant Surveyor General. 1 clerk 1 tracer.
Cadastral Surveys	4 European surveyors.

There are also two forest officers in the department.

PRESENT STATE OF TOPOGRAPHY.

No systematic survey has yet been made. All the evils which are attendant on patchwork survey may therefore be anticipated. These evils have been foreseen and a systematic survey has been recommended, but hitherto there has been no money for it.

THE WORK OF THE PAST YEAR.

Trigonometrical Branch.—None.

Topographical Branch.—None.

Cadastral Branch.—In the Carib Reserve at Stann Creek 382 blocks comprising 2,012 acres were surveyed. This entailed the cutting of over 48 miles of boundary lines and more than 15 miles of traversing.

The limit of error in the surveys is one link in ten chains and one minute in five angles.

COST.

Expenditure and Revenue.—The expenditure was roughly £4,000, and the revenue, mainly from timber licences and sale of Crown lands, was roughly £10,000. The survey, forest and land offices are all in one department, but the cost of survey is roughly £2,500.

CEYLON.

Governor	Sir R. CHALMERS, K.C.B.
Surveyor General	Mr. R. S. TEMPLETON.
Deputy Surveyor General ..	Mr. W. C. S. INGLES.
Assistant Surveyor General ..	Mr. A. J. WICKWAR.

ORGANIZATION OF THE SURVEY DEPARTMENT.

Field	10 Superintendents of Surveys. 1 Superintendent, Observatory. 2 Assistant Astronomers. 37 Assistant Superintendents of Surveys (27 temporary). 2 levellers. 267 grade surveyors.
Office	7 Assistant Superintendents of Surveys (6 temporary). 217 clerks and draughtsmen. 1 accountant. 150 extra clerks and draughtsmen.

Topography.

During the period under review, 1,161 square miles of flat work were surveyed at an approximate cost of Rs.70–94 per square mile.

One Assistant Superintendent and ten men were engaged upon the work, and the progress and accuracy of the work generally were satisfactory.

It is proposed to increase the staff by 10 men before the end of 1914, and arrangements have already been made for training this number.

Provincial maps of the following provinces on a scale of four miles to an inch have already been issued :—

Uva Province,
Northern Province,
North Central Province,
Eastern Province,

and the North Western and Central Provinces will be ready shortly.

Triangulation.

A little minor work was carried out to fill in gaps, principally in connection with the Block Surveys.

Narammala Scheme.—Ten points were visited, nine fixed and one refixed.

Nikaweratiya Scheme.—Nine points were visited, 12 points fixed.

Balangodan–Pelmadulla Scheme.—Eleven points visited and eight fixed.

Office work consisted of the calculations for the fixation of the points in the above schemes, the calculations of the altitudes for Topographical purposes of 143 Trigonometrical Stations from data available from Trigonometrical Records, the preparation of Trigonometrical diagrams and other work of a miscellaneous nature.

One Assistant Superintendent of Surveys and one Surveyor were employed on the above in addition to other duties.

Levelling.

Thirty-five miles of levels were run in duplicate, on the Anuradhapura-Trincomalee Road, at a cost of Rs.81–56 per mile, and 107 Bench Marks established at a cost of Rs.27–27 per Bench Mark.

Seventy-four miles were run on the Colombo-Galle Road, at a cost of Rs.86–42 per mile, and 193 Bench Marks established at a cost of Rs.33–15 per Bench Mark.

Office work consisted of tabulating level figures and preparing Level Sketches, with a view to getting the value of all Bench Marks published in one volume.

Two officers have been running these levels under the supervision of the Assistant Superintendent of Surveys in charge of Triangulation and Levelling. The progress of the work has been very satisfactory.

Block Surveys (including Settlement and Demarcation Surveys).

The average number of men employed on this work was 16 Assistant Superintendents and 126 Surveyors.

An area of some 21 000 acres was block surveyed at an approximate cost of Rs.3 per acre, including landmarking. This small output was due to the fact that the greater part of the staff was employed on Settlement and Demarcation Surveys in connection with the old plans. This latter work is slow and intricate in addition to being disconnected and distributed over a large area. Making the necessary sub-divisions, cutting out the owners' claims, investigating old boundaries, etc., etc., entails a large amount of very tedious work with very little show for it. It must be noted here, however, that this work is now rapidly drawing to a close, and it is hoped by the end of 1914 the greater part of the old plans will have been dealt with. The new Block Surveys are subdivided and landmarked, as far as possible, at the time of survey, and approximate very closely to a Cadastral Survey. Dealing with the work in this manner will increase the outturn and facilitate subsequent settlement surveys. The rate of progress and accuracy of the work done throughout was, taking the exceptional circumstances into consideration, very satisfactory.

Application Surveys.

This class of survey consists principally of the survey of small isolated lots of Crown land, made on the application of intending purchasers. The staff also attends to all surveys under the Acqui-

sition Ordinance, Special Surveys for Revenue Officers, examination and checking of surveys for Certificates of Quiet Possession, Irrigation and Town Surveys. It is difficult to give details of such varied and intricate work, but it is now well up to date, the Provincial Closure System for Application and Special Surveys having proved most satisfactory, and having enabled the surveys to be made in a more systematic manner and arrears overtaken. Some 66 men were employed on this work and attended to 2,638 questions, at a cost of Rs. 211,349.

Training School.

An Assistant Superintendent and two Instructors are in charge of this school, which had 15 surveyors in training for the Department and five qualifying to practise as licensed surveyors.

The students are given three months training in the Colombo Training School and three months at Padukka, twenty miles outside Colombo, where practical work is done in all its branches.

Cost.

The cost of the department was roughly £133,000. The proportional cost was roughly :—

	Per cent.
Personal emoluments	50
Other charges	46
Special expenditure	4
	100

CYPRUS.

High Commissioner	Major Sir H. J. Goold-Adams, G.C.M.G., C.B.
Registrar General and Director of Surveys	Mr. F. Ongley.
Assistant Director of Surveys ..	Mr. B. T. Watts.

Organization of the Survey Department.

Field.

Trigonometrical Section ..	1 Chief surveyor. 1 Assistant. 3 Traversers. 1 Surveyor. 1 Surveyor sent from England for major triangulation of Island. 1 Assistant and interpreter.
Detail Survey Section ..	1 Chief surveyor. 1 Assistant. 9 Surveyors.

Office.

Headquarters	Director of Surveys. Assistant Director of Surveys. 1 Clerk and storekeeper.
Computation Office ..	Chief Computation Officer. 1 Surveyor. 1 „ on probation. 2 Clerks.
Coordinatograph	1 Clerk.
Drawing Office	4 Draughtsmen. 1 Clerk, sunprinting, etc.

The Work of the Past Year.

Trigonometrical Section.

Triangulation.—During the early part of the year the third order triangulation was joined up to the Armiridia base at the east end of the island. Observations were taken at all points. Fourteen points had to be re-observed owing to their destruction by wandering shepherds. The average triangular error of this triangulation was 4·12″.

It was necessary to start the Detail Survey as soon as a few triangles had been observed, for this reason the computations were carried on polygon by polygon and the whole work was not computed *en bloc*.

The length of the check base at Armiridia by triangulation was found to be 3,287·68 feet, and by actual measurement 3,287·23 feet.

165 minor triangulation points (4th order) were fixed from the 3rd order points either by resection or intersection.

A second order triangulation of the island had been completed under the then Director of Survey, Captain Kitchener, R.E., in 1878–82 for the purpose of forming a topographical map of the Island on the scale of 1 inch to the mile. This triangulation was found to be too rough for use with the Detail Survey and, as practically none of the original points now remain (including the base points) and no records of the computations are to be found, a new triangulation of the island was recommended by Captain Lyons, R.E., F.R.S., in his report on the Cadastral Survey of Cyprus.

In August a N.C.O. of the Royal Engineers was deputed to do the reconnaissance for this triangulation; the work was carried out rapidly, as with a few exceptions the points were placed near the portions where the original points must have been.

Some trouble was caused at Famagusta on account of a peculiar mirage at that place.

During the summer reconnaissance the Famagusta minaret was quite clear from Pyla, but the observer found in the winter that Famagusta was invisible—on this account alterations were made in the base extensions measured in 1912. Twenty-eight points have now been observed and 15 remain to be done. Astronomical observations have been taken at one base for latitude and azimuth.

Reconnaissance for a 3rd and 4th order triangulation was commenced in the Larnaca District in January and 41 third order points and 15 fourth order points have now been definitely fixed. Observations at the third order stations will commence this month and the fourth order points will be intersected from them.

A plane table-alidade-tacheometer survey will be run off these fixed points and a map constructed on a scale of 1 : 5000. No map exists except the 1 inch to a mile, and as it is found necessary to complete the valuation of the island in ten years the above Survey was proposed.

The allowable error in the closure of the triangles was fixed at 8″—this was exceeded on a few isolated triangles near the coast where the forests made observing extremely difficult.

Traverses.—The Traverse section of the Field Staff have improved considerably both in the quality and pace of the work.

82,030 acres have been covered with a chain and theodolite traverse and 2,816 points were observed, this includes points placed in 18 villages, the survey of which is carried out on a scale of $\frac{1}{1250}$.

As the work is in the hilly parts of the island all lines have to be stepped—the average error put into the chained lines is about $\frac{1}{850}$. Three men were employed regularly on this work during the year.

Detail Survey Section.

During the year 51 plans have been surveyed on a scale of $\frac{1}{2500}$. and 12 villages on a scale of $\frac{1}{1250}$. Most of these plans have been finally examined on the field by the Chief Surveyor and his assistant. The total area surveyed was 65,500 acres.

The apparently small area surveyed is accounted for by the small staff employed on this work, the many difficulties encountered in the hilly district of the Karpas, and the large amount of work outside the actual survey of the land, which the surveyor has to perform.

The country is divided up into very small properties, the divisions of which are difficult to ascertain, as the proprietors fail to attend the surveyor, who has to rely on the often inaccurate information of the village representatives. Large numbers of taxable trees have to be counted and booked against their respective owners and often a single tree is owned by many people and does not go with the land on which it is situated.

Topographical Section.

No work has been carried out in the field.

The 1 : 2,500 plans are being reduced to form a topographical map of the island on a scale of four inches to the mile. 137 plans were reduced during 1913–14.

Sunprints for valuers and field clerks were prepared in respect of .. .. 11 plans.
Numbering .. .. 16 „
Numbers and names inserted and finally completed .. .. .. 105 „

Computation Office.

The following work has been completed during the year:—
Computation of Karpas triangulation by method of least squares.
Computation of 130 4th order points.
Computation of co-ordinates of 3,000 traverse points.
Computation of areas was formerly taken out in the field, this is now done in the Head Quarters Office.

Most of the year's work consisted in correcting the mistakes made under the old system of work when areas were only taken out once and not checked. Of the new work eight plans and three villages were completed. Two areas were taken out for each plot by different computers, adjustment made for shrinkage (or exhaustion) of the paper, and when the sum of the areas agreed with the theoretical area of the plan to within 1 per cent. the final adjustment was made.

Four more computers will be added for this work to keep pace with the valuation section.

A coordinatograph by Coradi of Zurich has been placed in the Computation Office. This machine has been found most useful in plotting the numerous traverse points.

Maps Published.

174 plans on a scale of 1:2,500 have been published and 29 villages on a scale of 1:1,250. £12 was realized by the sale of maps during the year.

Special Work Undertaken.

During the summer months assistance was given to the Railway Department in running a preliminary survey for the extension of the line from Morphou up to Evrychou valley.

No triangulation exists of this part of the country. A theodolite and chain traverse formed the basis of the work, and off this a plane table survey was made on a scale of 1″–4 chains; levels were run along the main line of traverse and sections of the valley taken off them.

Cost.

	£	*s.*	*d.*
Headquarters	2,235	5	6
Trigonometrical Section	1,785	7	10
Detail Survey Section	1,953	3	1
Special Work for the Railway Extension	108	1	6

Total cost of Survey branch, as distinct from the land registration branch, was therefore £6,081 17*s.* 11*d.*

FIJI.

Governor	Sir Bickham Escott, K.C.M.G.
Officer in Charge of the Trigonometrical Survey.	Mr. G. T. McCaw.
Assistant	Mr. T. Rimmer.

Island of Viti Levu.

The Report of the Survey of Viti Levu is complete except as regards the adjustment and coordinates of some secondary stations.

The allocation of the labour of adjustment has been as shown in the following table :—

Main Figures.		Figs. of 2nd Order.		Intersected Points.	
No.	Conditions.	Complete.	Incomplete.	Complete.	Incomplete.
7	62	3	0	29	5
6	77	2	2	0	12

(All finished).

An extract from the statistics of the Triangulation will indicate the quality of the work.

Main Net.

Number of Triangles	173
Average closing error of Triangle ..	1″·51
Probable error of observed angle (Ferrero's)	±0″·75
Probable error of observed angle (from adjustment)	±1″·43
Probable error of observed angle, excluding figures X and XII ..	±1″·13

Intersected Points.

Probable error of observed angle from adjustment, about	±2″·0

Altitudes.

Average range in measures of height of primary point	1·9ft.
Average range in measures of height of intersected points	2·9ft.

Density of Triangulation.

Total number of stations fixed	112
Side of average square containing one main station	9 miles.
Side of average square containing one station fixed .. .. (excluding stations fixed purely for photogrammetry).	6 ,,

Island of Vanua Levu.

Measurement of Base.—The Tuatua base of 18,480 feet, about 3½ miles, was measured in May, when the reclaimed mangrove swamp was sufficiently dry to afford firm footing. The eight sections were twice measured by a staff of three officers in 17 field days. The chief trouble arose from the crossing of small creeks and numerous drains, but with the help of the preliminary chaining made by Mr. Rimmer and the simple expedient of twice adding certain lengths of a steel tape and deducting the *same* lengths at later stages, practically every obstacle was scientifically surmounted.

The levelling was carred out by Mr. C. L. Leembruggen, of the Lands Department, using a 14-inch Cooke level and a short staff (designed by Mr. McCaw) with two incommensureable scales, black and red. The two measures of the difference of level of the two terminals differ by ¼ inch The maximum discrepancy in a section is 7–10 inch and the average 3–10 inch, *i.e.*, slightly less than ½ inch in one mile.

The difference between the forward and backward measures of the length of the base is 3–11 inch = 1 : 818,000. The average discrepancy on a section is 1–16 inch, the maximum being 1–9 inch. The tape apparently lengthened between the periods of standardization at Southampton before and after measurement by 1 : 1,400,000—an amount less than the natural elongation with time of stoved invar. The final p.e. of the base is 1 : 364,000 or ±3–5 inch.

Mean Sea Level.—A tide-gauge was established at Malau, near Labasa, and three months' observations were made here (July-September, 1913) by an intelligent Chinaman. The connection between a B.M. opposite the tide-gauge and the Tuatua base involves 10 miles of spirit levelling, and work on this line is at present (March, 1914) being pursued by Mr. Rimmer. Intermediate concrete bench marks have been set up at suitable points along the route, which passes the Labasa Sugar Mill.

Astronomical Observations.—Latitude was determined at Numbuiloka in July, which, though ordinarily a good month, was most unsatisfactory for observers in 1913. After long delays a clear spell of just two hours duration supervened on July 10th, and latitude was then determined by the Gauss method from eight trials of stars; the p.e. is ±0″·53. The observers remained on the hill eight days more endeavouring to get observations for azimuth, but as no clearance ensued the hill was abandoned and the determination postponed until the occupation of Naseula (Base East) at the end of the month. Here observations were conducted with success on four nights. The method employed was that of low stars in the prime vertical. The p.e. of azimuth is +0″·47.

Reconnaissance.—With the exception of a few hills in the Taviuni District and one other, the stations have been selected and beaconed by Mr. Rimmer. Dr. Guppy's contoured map has been a valuable aid in this work, which, as far as mere choice of stations is concerned, has been relatively easy in Vanua Levu, if the Taviuni district be

excepted. The total number of stations already beaconed is made up as follows:—Main stations, 29; secondary, 30.

It will be seen that the reconnaissance of Taviuni is not yet complete. This island has presented unusual obstacles. Normally it is capped with cloud which rarely uncovers the axial ridge. In response to local request an endeavour has been made to establish a ring of stations round the island below normal cloud level, which is about 2,750 feet. This scheme is, however, fraught with difficulty. Owing to the configuration and more especially the straight axis of Taviuni, the essential intervisibility of signals is not easily obtained without undue multiplication of stations and undesirable complexity in the triangulation. When finally the stations are established the observational difficulty remains; to distinguish opaque signals against a dark near background is only possible where the observer is at a comparatively short distance from the signal. Consequently the helio must be utilized on the longer lines. Considering, however, the persistence of cloud on the ridge it is possible that the labour of observing a double number of low stations will not be a whit greater than the observation of a normal number in the cloudy strata. High stations, moreover, would be permanently disadvantageous.

Angle Measurement.—The computation of the work in Viti Levu and the measurement of the Labasa Base absorbed most of the time of the officer in charge during the earlier part of 1913. Consequently the strictly trigonometrical work was not undertaken till June. Thereafter this work was again interrupted by astronomical observation. Fourteen main and five secondary stations have been occupied, the observations at four of the secondary being made by the assistant, using a 5-inch vernier theodolite. The observations to 19 secondary points are complete.

Computation.—In the intervals of waiting during broken weather on the hills, the completion of the Report of Viti Levu has principally occupied the attention of the leader. Since coming into office both officers have been engaged on the preliminary computations of Vanua Levu, until Mr. Rimmer was requested to undertake the levelling to Malau, which is now being carried on when the weather is propitious. Preliminary distances and altitudes of all main and secondary points have been computed and a beginning made with the laborious work of adjustment.

HONG KONG.

Governor	..	Sir F. H. May, K.C.M.G.
Director of Public Works	..	Mr. W. Chatham, C.M.G.
Principal Land Surveyor	..	Mr. L. C. Rees.

Organization of the Survey Department.

The Land Survey Office, which at present includes a staff of 11 surveyors and one native apprentice surveyor, is a branch of the

Public Works Department and is under the control of the Director of Public Works.

All matters relating to the sale and occupation of Crown Lands, which are under the charge of the Director of Public Works, are dealt with in this office, such as applications for land, sales of all areas to be let on long leases, preparation of permits for temporary occupation of land, licences for temporary piers, plans for leased areas, quarries, permanent piers, etc., etc.

The taking out of co-ordinates of traverses, the calculation of areas, etc., are done by the two computers engaged in 1911, the results being finally checked by the surveyors, after each set of figures has been worked out independently by each of the computers. This system has proved very satisfactory and a great saving of time has been effected. When all co-ordinates have been taken out and proved, the surveyors then plot their own traverses and fill in the details.

The Work of the Past Year.

Triangulation.—With the exception of the Tung Hoi, or Eastern Districts of the New Territories and a portion of Lantao and Lamma Islands, the triangulation of the Colony has now been completed, and 40 main and 55 minor Trigonometrical stations have been permanently marked on the ground by beacons or cairns of stones.

The area covered is equal to 300 square miles, and the work was extended by a series of interlacing polygons accurately closed in the office with an angular error of about 6″, with one exception, the Lantao Island-Cheung Chau Island section. The error in this series was slightly more owing to the fact that observations had to be taken during the foggy and hot season to allow the survey of Cheung Chau Island to be undertaken. The triangulation has now been closed on the original base and checked with the Military Harbour Survey base with satisfactory results. The majority of the minor Trigonometrical stations were fixed in the more populous and cultivated districts such as Taipo, Sheung Shui, and Pat Heng Valleys to enable the survey of the principal villages to be undertaken.

All polygons have been accurately closed, and all stations valued and recorded in the office.

Topographical and Cadastral Work.—About 135 miles of traverse, including a 20-mile traverse from Castle Peak to Fanling, have been run during the year and traverse stations permanently marked on the ground. The limit of error allowed for this work is 1 in 3,000.

A portion of the Western District of the City containing about 15 acres was surveyed in detail and plotted on the Ordnance plans. Some progress was made with the survey of Kowloon ; the survey of Ma Tau Wei and district was practically completed and partially plotted. Kowloon Farm Lots 3 & 4 and surrounding lots containing an area about 806,900 sq. ft. were surveyed and plotted, but owing to lack of staff and the numerous surveys necessitated by applications for land, new leases, etc., it was not possible to keep surveyors continuously on this work.

An area of about 36 acres was surveyed and contoured at Taipo in connection with certain applications for building lots.

One surveyor was engaged for several months in making a detailed survey of the British Section of the Kowloon-Canton Railway and the adjoining lots. This survey was required to finally settle the boundaries of the land taken over for the construction of the line and close the railway land resumption account.

A main traverse was run along the centre of the railway track, commencing at the south face of the Beacon Hill Tunnel and finishing at Sham Chun on the Chinese Border, and was closed on five trigonometrical points on the way.

Subsidiary traverses were run from permanent marks left on the main traverse for the purpose of picking up detail, such as sidings, stations, cuttings, banks, etc., and over 1,500 lots of cultivated land adjoining the railway were either wholly or partially surveyed. All this work has been plotted on the Ordnance plans to a scale of 200 feet to one inch and boundary stones have been fixed defining the area taken up by the railway.

A survey of Cheung Chau Village, the Island of Cheung Chauin, containing 500 houses, and about 30 European building lots situated in various parts of the Island has been made.

In addition to the work described above surveys were made and sale plans prepared of 33 plots of land in Hongkong and Kowloon. These lots covered an area of 802,163 square feet.

Cost.

The cost of the survey branch, excluding charges for lighting, heating, &c., which cannot be separated from the cost of the Public Works Department, amounted to roughly £6,000. The proportional cost was:—

	Per cent.
Salaries	78
Conveyance allowances	7
Wages for coolies	6
Land survey expenses (camp equipment, &c.)	4
Triangulation	3
Transport and travelling expenses	1
Incidental expenses	1
	100

JAMAICA.

Governor	Brigadier-General Sir W. H. Manning K.C.M.G., C.B.
Surveyor General	Mr. C. Liddell.

Organization of the Survey Department.

There is no recognised survey department, but any cadastral surveys that are necessary are made by the Crown Lands Department, consisting of the Surveyor General, three assistant surveyors, one accountant, three clerks, one typist and 132 baliffs and headmen.

The Work of the Past Year.

No Trigonometrical or Topographical survey has been undertaken.

Cadastral Survey.—This work includes surveys of lands forfeited to the Crown for non-payment of taxes and the delimitation therefrom of tax-paid areas belonging to private owners, of lands recovered from squatters or by escheat of lands sold by the Crown, and of land purchased by the Crown. These surveys were all, except in cases of opening of boundary lines, closed traverses with closing errors of from 1 in 450 to 1 in 900. 150¾ lineal miles of survey and traverse work have been performed in addition to about 100 miles of reconnaissance and locating work. There are large areas requiring boundary lines and road schemes before the land can be offered for sale.

The cost of the survey and traverse work was approximately £6 a mile, and the average rate of speed about 40 chains a day.

Maps.—A large number of maps, plans, and tracings have been made for official use, and 67 plans have been made to the order of the public for defining boundary lines of properties or for the information of proprietors. A closed compilation of the whole Island to a scale of one mile to an inch has been completed and inked in, and the topography partially drawn on. The total expenditure on the map has been only £389 2*s*. 8*d*. out of an estimated total of £2,000.

Cost.

It is impossible to extract figures for the survey branch alone. The total expenditure for the whole department was £3,427 and the total revenue £4,439.

MALAY STATES.

High Commissioner	.. ..	Sir Arthur Young, K.C.M.G.
Surveyor General	.. ..	Colonel H. M. Jackson, late R.E.
Deputy Surveyor General	..	Major G. S. Knox, R.E.

The Work of the Past Year.

Trigonometrical Branch.

The Trigonometrical Branch being again very shorthanded during 1913, the work carried out was necessarily limited. The observations from 15 stations of the Kelantan triangulations were, however, completed. The whole of this work will, it is hoped, be finished in 1914. Parts of the country traversed on this work are amongst the wildest in the Peninsula. On the long and difficult ascent to G. Noring on the main watershed the survey party saw no signs of man for seven days. The important traverse and triangulation along the Pahang river for the control of the surveys of the numerous settlements along this great waterway was considerably advanced, leaving only 33 miles yet to be dealt with.

The traverse commenced in December, 1912, along the rugged watershed of the main range between Selangor and Pahang was continued, and the part most important for the control of the mining surveys on either side completed.

The precise levelling was carried on continuously during the year, 245 ordinary bench marks and 25 permanent marks being emplaced.

Minor triangulation of secondary value—*i.e.*, sufficiently rigorous for the control of the land surveys, was commenced in the district of Upper Perak for the more immediate purpose of supplying points for the control of the topographical survey to be extended into this part of the country in 1914; and the traverse along the Perak river was continued for about 37 miles and for the same purposes.

Base lines to ensure the preservation of the scale of measurement were selected and prepared in Kelantan for the Kelantan triangulation more particularly, and in Kedah for the proposed revision of the principal triangles of the main triangulation of the Peninsula.

The computation of tidal data at Port Swettenham from the records of the automatic tide gauge was carried on.

The cost of ordinary traverses remained about the same. The cost of that along the Selangor-Pahang watershed was very high on account of its position, the nature of the country and labour difficulties.

Topographical Branch.

The normal progress of the (one inch to the mile) topographical survey suffered considerably from lack of supervision during 1913, owing to the absence on leave of the Superintendent and the employment of the Acting Superintendent on special work during five months of the year. With the exception, however, of about 20 square miles of detail and some final examination of the ground, the proposed programme was carried out. This comprised two standard sheets, one containing part of the Plus valley and the other part of the Perak valley—in all about 595 square miles. The cost of the work in the former sheet, which includes some difficult hilly country, is about

£8 5*s*., including all charges ; and of the latter, which contains mostly easier country, though partly very swampy, about £6 10*s*. per square mile. The average cost of the field work during 1913 comes to about £6 14*s*. per square mile, including supervision and all field expenses. This shows a considerable reduction on previous rates, and indicates satisfactory increase in efficiency of the field hands.

A special survey was undertaken with a view to obtain a basis for the planning of the proposed sanatorium or hill station of "Gunong Tahan." The total area thus dealt with was 14·3 miles. A complete meteorological record was kept up, and several streams gauged for estimation of water supply. Owing to the difficulty of communications and therefore of supply and, during part of the time, to bad weather, this work occupied longer than was anticipated, and was attended by considerable hardship. Other special topographical work carried out was the continuation of the detail survey of Kuala Lumpur town on the scale of one chain to the inch. The field work of this was practically completed, excepting for the examination of some parts of it by the end of the year.

Colonial Survey Section.

This Survey Section consisting of two officers and four non-commissioned officers of the Royal Engineers continued the topographical work in Negri Sembilan. In September the strength of the Section was increased by the addition of two more non-commissioned officers, thus effecting a more economical proportion between the detail topographers and the officers in charge of the preparation of the necessary framework of control and of the final examination of the work. During the year one full sheet was completed and another, containing a strip of coast about Port Dickson, was finished all but the final examination. Work was carried on also in parts of three other sheets which will be finished probably during the first half of 1914. In all, 472 square miles of detail were completed during the year under report. Progress was considerably impeded by rain, by occasional sickness and be parts of the country under survey being flooded at times. The cost of the detail work alone, excluding the officers' parties, which were chiefly engaged in clearing and fixing points ahead for the extension of the detail, was about £6 8*s*. per square mile. When the addition of the two extra topographers begins to make itself felt this cost should be found to have been somewhat reduced. The average rate per man per working day was 0·51 per square mile. As indicating the difficulty of anything like rapid progress in topographical work in a wet uncertain climate without any regular seasons, it may be noted that the average number of full working days in each month is about 17, allowing for a fortnight's leave during the year, public holidays and Sundays. The remainder of the time is lost by rain, sickness, moving camps and delays, generally due to difficulties with coolies.

Revenue Survey Branch.

The progress of the land surveys during 1913 may be considered as fairly satisfactory. In all, 270,375 acres (about 422 square miles) were surveyed for registration of title—in some form, or for reserve to the State. This is about 5,500 acres more than last year. There is an increase also in the return of total chainage from 642,001 to 663,958. The average cost per acre and of drainage have both, however, also slightly increased. The increase in cost per acre is due to the fact that a lesser number of large rubber estates and forest reserves and a much greater number of small portions were surveyed in the year under report compared with the preceding year, this difference being particularly marked in Perak. The slight increase in the cost of chainage is probably due to increase in transport and labour expenses on mining surveys on the high lands of the Raub and Bentong districts and to the difficulties of work amongst the limestone cliffs of Kinta, where a good deal was done during 1913. The average cost per acre in 1913 was 4*s.* 0*d.*; in 1912, 1*s.* 6*d.* The average cost per chain in 1913 was 1*s.* 7*d.*; in 1912, 1*s.* 6*d.*

There has been a diminution in the demand for extensive areas for rubber plantation during the year. The number and average area of mining lots applied for appear to be about the same as in the preceding year. There is a great increase in the number of requisitions received for native holdings. Some large tracts of country gazetted as forest reserves are recorded as for survey in 1913, but have not been completely dealt with.

As regards surveys still on the books of the department at the end of the year: those for agricultural purposes have been considerably reduced both in area and in number. There is a small increase, however, in the arrears of surveys of mining lots and of native holdings. There is a very large increase in the area of forest reserves to be dealt with. Except for the last-mentioned item, which is not important from the point of view of urgency, the department is much in the same position as last year. All old outstanding arrears that can be dealt with at all have now been practically wiped off, though much revisionary work still remains to be done in Negri Sembilan, the legacy of unscientific methods in the past. There was a slight general increase in the effective strength of nearly all grades in the Revenue Survey Branch during 1913.

Central Drawing Office and Photo-Lithographic Section.

Three sheets of the topographical survey of the Malay States were published during the year, the whole of the work having been carried out in this office. The fair maps are drawn on the scale of one and a half inches to the mile for photo-reduction in order to produce fine clear lines and lettering. Other maps completed during the year under report included a map of the Anglo-Siamese Boundary Commission on the scale of $\frac{1}{250000}$, a map of Seremban and environs from the survey of the Colonial Survey Section on the scale of two inches to the mile, several sheets of the Kuala Lumpur Town (topographical) survey, sketch maps of Kedah and Perlis, and revenue survey maps

of several districts and towns. A large number of progress index maps and charts, diagrams, railway maps, posters and illustrations for various reports, etc., was also printed. The total number of impressions was 126,772.

Nine topographical sheets, including two of the Colonial Survey Section's work, are in hand in various degrees of completion.

The Technical School passed out 26 probationers for the Department —mostly for the Revenue Survey Branch.

The number of surveyors employed on different classes of surveys was as follows :—

	Europeans.	Others.
Trigonometrical Survey	8	—
Topographical Survey	4	13
Colonial Survey Section	6	—
Revenue Surveys	50	61

TRINIDAD.

Governor .. .. Sir GEORGE R. LE HUNTE, G.C.M.G.

Engineer in charge of Surveys .. Mr. E. R. SMART.

ORGANIZATION OF THE SURVEY DEPARTMENT.

Staff .. .. Engineer in charge of Surveys.
2 Assistants.
4 Draughtsmen.
1 Clerk

THE WORK OF THE PAST YEAR.

Triangulation.—None. The triangulation has been completed.

Topographical.—About 70 miles of road have been surveyed and entered on the standard sheets.

Cadastral.—One large estate of about 2,000 acres has been re-surveyed, and 390 other surveys, varying in extent from 5 to 96 acres, of a total area of 2,096 acres, have been surveyed for the Crown Lands Department.

Map production.—One map of Trinidad on scale $\frac{1}{150000}$ has been published in colours, shewing alienated lands, forest reserves, roads, railways, and ward boundaries.

COST.

	£	*s.*	*d.*
Salaries	1963	6	8
Travelling	226	13	0
Surveys	1,889	15	0

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page:—

ANNUAL.

No.	Colony, &c.	Year.
792	Grenada	1912
793	Leeward Islands	1912–1913
794	St. Lucia	,,
795	St. Vincent	,,
796	Bermuda	1912
797	Ceylon	,,
798	Gibraltar	1913
799	St. Helena	,,
800	Turks and Caicos Islands	,,
801	Seychelles	,,
802	Ceylon	,,
803	Bermuda	,,
804	Weihaiwei	,,
805	Gambia	,,
806	Gold Coast	,,
807	Northern Territories, Gold Coast	,,
808	Sierra Leone	,,
809	Bahamas	1913–1914
810	Cayman Islands (Jamaica)	1912–1913
811	Fiji	1913
812	Ashanti	,,
813	Basutoland	1913–1914
814	Hong Kong	1913
815	Bechuanaland Protectorate	1913–1914
816	Imperial Institute	1913
817	Falkland Islands	,,
818	Malta	1913–1914
819	Trinidad and Tobago	,,
820	Jamaica	,,
821	Northern Nigeria	1913
822	Grenada	,,
823	Zanzibar	,,
824	Barbados	1913-1914
825	Southern Nigeria	1913
826	Mauritius	,,
827	British Honduras	,,

MISCELLANEOUS.

No.	Colony, &c.	Subject.
78	Weihaiwei	Census, 1911.
79	Northern Nigeria	Mineral Survey, 1907–8 and 1908-9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments, &c.
85	Southern Nigeria	Mineral Survey, 1911.
86	Southern Nigeria	Mineral Survey, 1912.
87	Ceylon	Mineral Survey.
88	Imperial Institute	Oilseeds, Oils, &c.
89	Southern Nigeria	Mineral Survey, 1913.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S
STATIONERY OFFICE
By BARCLAY AND FRY, LTD., SOUTHWARK, S.E.

1915.

COLONIAL REPORTS—ANNUAL.

No. 1230.

REPORT

OF THE

COLONIAL SURVEY COMMITTEE

For the period 1st April, 1914, to 31st March, 1923.

(*For previous published Report see* No. 828—Cd. 7622–19.)

LONDON:
PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
Adastral House, Kingsway, London, W.C.2; 28, Abingdon Street, London, S.W.1;
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or 120, George Street, Edinburgh;
or through any Bookseller.

1924.

Price 2s. 6d. Net.

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British Honduras (1913–1923)	5
Ceylon (1914–1923)	8
Cyprus (1915–1923)	11
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Hongkong (1915–1923)	20
Jamaica (1915–1922)	24
Kenya (1914–1921)	28
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No. 1230.

COLONIAL SURVEY COMMITTEE REPORT.

For the period from 1st April, 1914, to the 31st March, 1923, including a Précis of Information on the Surveys of West Indian Colonies.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

H. J. READ.
E. M. JACK, *Colonel, D.G.O.S.*
H. S. L. WINTERBOTHAM, *Colonel, General Staff.*
C. F. CLOSE.

G. T. McCAW.
P. LIESCHING. } *Secretaries.*

November, 1924.

[*Note.*—The Series of Annual Reports of the Colonial Survey Committee was broken after the 9th (1914) number by the war. In the period which has elapsed since the Armistice, the collection of data concerning various surveys was resumed and met with considerable difficulty.

The Report is nevertheless unusually large, and for reasons of economy no diagrams are included. The Catalogue of Publications of the Geographical Section, General Staff, War Office, price 2*s.* 6*d.*, will be found a useful guide in identifying areas mentioned in the Report.]

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BRITISH GUIANA.

(*See also p.* 58.)

Governor:
Sir Graeme Thomson, K.C.B.

Commissioner of Lands and Mines:
Mr. G. D. Bayley.

Proposed Framework Survey of the Colony.—The annual reports from this Colony are not available, but Combined Court Paper, No. 34, 1923, contains information regarding a proposal to start a colonial framework. This proposal, first brought forward by an Elective Member in 1912, is based on the general view that " if the country is to be developed it is essential that reliable information should be available in regard to its topographical, geographical and geological aspects."

At present no framework exists wherewith to control either cadastral or economic surveys, which are of the nature of patchwork. The terrain is generally forested and, except in the savannahs of the west and south-west, there are few hill features exceeding 1,000 feet in elevation. Triangulation, except in the savannahs, would be difficult and costly; so that the Colony proposes to adopt a framework of main traverses, as suggested by Colonel H. W. Gordon, R.E., in 1910. Traverses of this kind, rigorously surveyed and adjusted, would follow the main rivers and be controlled by cross ties and numerous astronomical observations. It is proposed further to survey, both topographically and economically, the country within 5 miles on either side of the main traverses, which in the first instance will follow the rivers of greatest potential development. The cost is estimated at £80 per mile run.

If the scheme as proposed is rigorously followed, there is little doubt of its eventual success. But if precision is to be attained, and if the framework is to be durable, a certain standard of accuracy must be laid down at the outset and faithfully followed throughout the years, and the stations must be marked with material more permanent and less easily removed than hardwood paals. The standards and methods adopted by Colonel H. M. Jackson, in the F.M.S. would supply useful indications of the desirable accuracy of such work in similar country and the best manner of putting it into effective execution.

For the topographical work, it is essential to have longitudes; these can now be determined with such comparative ease by the wireless method that they may be fixed anywhere from the signals sent out by such stations as Annapolis (Maryland), Arlington (Washington) and Bordeaux (France).

Contract Surveys.—It is proposed to lighten the work of the Department of Lands and Mines by giving out to contract the surveys of agricultural and wood-cutting holdings. It may therefore be desirable to reconsider the tests of the qualifications of the licensed surveyors who will conduct this side of the cadastral work, since all titles to Crown Lands should be above suspicion; the question may arise as to the adaptability of the Land Surveyors' Ordinance to modern methods and needs.

BRITISH HONDURAS.

(*See also* p. 62.)

Reports available for all years from 1913 *to* 1923.

Governor:

1913–7.	...	...	Sir W. Collet, K.C.M.G.
1917.	...	...	R. Walter, Esq. (*Acting*).
1918.	...	...	W. Hart Bennett, Esq., C.M.G.
1919.	...	...	Sir Eyre Hutson, K.C.M.G.

1. *Staff.*—During the period under review (1913–1923) there were three Surveyors-General: Mr. H. I. Perkins, I.S.O., up to May, 1919; Mr. W. H. Carlin (Acting), from May, 1919, until October, 1920; and Mr. F. W. Brunton thereafter. The Staff throughout the period was constituted as follows:—

Period.	Surveyor-General.	Assistant Surveyor-General	Surveyors.	Assistant Surveyors.	Temporary Surveyors.	Probationary Surveyors.	Forest Officers.	Assistant Forest Officers.	Temporary Forest Officers.	Draughtsmen.	Tracers.	Temporary Inspector of Crown Licences.	Clerical Staff.	Total.
1913–4 ...	1	1	—	3	1	—	2	—	—	—	1	—	2	11
1914–6 ...	1	1	—	3	—	—	2	—	—	—	1	—	2	10
1916–8 ...	1	1	—	3	—	—	1	1	—	—	1	—	2	10
1918–20...	1	1	—	3	—	—	1	1	1	—	1	—	2	11
1920–1 ...	1	—	—	2	1	—	1	2	1	—	1	—	3	12
1921–2 ...	1	—	—	1	1	—	1	1	1	1	1	—	4	12
1922–3 ...	1	—	2	—	—	2	—	—	—	1	1	1	3	11

2. *Expenditure and Revenue.*—The expenses of the Survey Department and the revenue received are shown in the following table. The revenue here given is made up from Royalties on Timber, Petty Licences, Sales and Rents of Crown Lands, Sales of Licences and recovered costs of the execution of Special Surveys. It does not include the Land Tax, which averaged a little under £5,000 per annum. In the table the dollar is taken at 4*s*. and figures are given to the nearest £50.

Year.	Expenditure.			Revenue.					
	Personal Emoluments.	General Expenses.	Total.	Timber Royalties.	Petty Licences	Rent of Crown Lands.	Sale of Crown Lands.	Plans and Special Surveys.	Total.
	£	£	£	£	£	£	£	£	£
1913–4 ...	2,850	1,300	4,150	2,650	100	1,550	800	300	5,400
4–5 ...	2,700	1,300	4,000	800	50	1,450	900	350	3,550
5–6 ...	2,700	1,300	4,000	2,200	50	1,650	600	250	4,750
6–7 ...	2,750	1,400	4,150	3,650	50	1,500	650	400	6,250
7–8 ...	2,750	1,300	4,050	6,700	100	2,000	1,050	350	10,200
8–9 ...	2,900	1,200	4,100	5,050	50	1,700	450	350	7,600
9–20 ...	3,250	1,200	4,450	7,600	50	2,600	300	—	7,600
1920–1 ...	3,700	1,900	5,600	4,200	100	2,700	200	50	7,300
1–2 ...	3,300	2,000	5,300	3,900	50	2,950	150	150	7,200
2–3 ...	3,500	1,800	5,300	2,700	50	2,550	300	350	5,950

The reports contain remarks bearing on the fluctuations in this table. In 1915 the mahogany industry was severely upset and bush labourers out of employment were forced to take up land; this desire to acquire land was enhanced in 1916 by the increasing price of foodstuffs. By 1917, accordingly, wages and food of labourers had increased.

3. *Trigonometrical and Topographical Survey and Levelling.*—Throughout the period 1913–23 neither trigonometrical nor topographical work of any kind was carried out.

The reports contain no direct reference to levelling except in the year 1919–20. In this year a small area near the Barracks, in Belize, was levelled for the purpose of reclamation from tidal overflow.

4. *Cadastral Work.*—The main function of the Survey Department is naturally cadastral; the table below gives a précis of the block surveys and the traverses executed in the various financial years. Areas are given to the nearest 50 acres and traverses to the nearest 5 miles.

Year.	Block Surveys.			Traverses.		Office Work.					
	No. of Blocks.	Average Size.	Total Area.	No.	Total Length.	Plans.	Tracings.	Applications.	Flats.	Petty Licences.	Leases Cancelled.
		Acres.	Acres.		Miles.						
1913–4	470	8	3,750	3	50	4	570	?	?	?	?
4–5	100	41	4,100	3	30	4	450	?	?	?	?
5–6	90	34	3,050	8	85	—	430	?	?	?	?
6–7	410	12	5,050	4	35*	—	470	?	?	?	?
7–8	130	21	2,800	4	60*	3	540	?	?	?	?
8–9	430	9	4,000	7	15	5	500	?	?	?	?
9–20... ...	160	17	2,750	5	25	?	?	860	260	190	170
1920–1	40	59	2,350	2	5	?	?	650	140	220	70
1–2	30	—	33,500†	2	35	?	?	580	70	270	55
2–3	20	28	550	6	60	?	?	580	390	250	80

The Department was frequently engaged on the determination of questions of trespass, commonly on Crown Lands whereof the boundaries had not previously been demarcated. Some of the work during the period has involved the assignment and survey of the boundaries of Carib reserves.

Many of the blocks in the above table consist of town lots in Belize, Stann Creek, Punta Gorda, Monkey River and Benque Viejo; it might be advisable in future Colonial Survey Committee reports to dissociate these lots from the " blocks " in the table above, since their aggregate area is naturally small.

A survey of a considerable tract of low-lying land was executed on the west of the city of Belize, with a view to drainage by the new South Side Canal, to assignment of title and to subsequent allotment. Three hundred of the 430 blocks which figure in the above table in 1918–19 refer to this urban area.

The cost of cadastral survey varies considerably with the area of the block. In 1915 it averaged from 6*s*. to 8*s*. per acre.

5. *Traverses.*—Traversing in British Honduras is mainly executed for ends purely cadastral. Thus it is frequently employed to link new work with old—generally a risky procedure,

Notes.—(1) The traverses marked with an asterisk include 17 miles along the Guatemala frontier, northwards from Garbutt's Falls on the western branch of the Belize R. The boundary line was here overgrown and it had become difficult to delimit territorial rights on either side. A Guatemalan official was associated in the restored demarcation.

(2) The figures marked with a dagger involved the area lying between the northern boundary of the Riversdale and the southern boundary of the Blair Athol Estate and include two parcels of land of 100 and 300 acres, the boundaries of which were now defined; total acreage, 30,000.

but perhaps inevitable in the absence of a control of triangulation or main traverses. In the same sense it is employed to detect cases of trespass, the framework of the Colony being still inchoate. Nevertheless there has been a considerable amount of traversing for other purposes, such as road, railway and canal location; alignment of administrative and territorial boundaries; town extension; river and coast development and drainage. The permissible linear and angular errors are respectively 1 in 1,000 and 12 seconds per angle.

6. *Draughting.*—In future reports the omission of reference to the nature and preparation of plans and tracings should be rectified.

7. *Records.*—The Fiats enumerated in the last table include Grants, Leases and Licences to cut timber. The Petty Licences are for common timber trees, firewood, charcoal and sand.

8. *Generally.*—There is a reference in 1921–2 to the selection of trigonometrical stations for the much needed survey of the southern portion of the western frontier of the Colony, but up to April, 1923, nothing had been accomplished in this direction.

The references to levelling are of the briefest description; it may reasonably be considered that railway, road, drainage and generally traverses of an engineering nature would be very incomplete unless they were made the occasion for conducting simultaneous lines of level, with adequate bench marks. Again, it is advisable to distinguish between surveys where the stations are permanently indicated and those where reliance is placed on blazings, hardwood poles and other markings with a limited life.

As far as can be gathered from the reports the Department has carried on a good volume of work on lines which appear generally sound; but in the absence of a colonial framework the state of the surveys can never be satisfactory.

CEYLON.

Reports available for all years from 1914 *to* 1923.

Governor:

1914–16	...	Sir Robert Chalmers, K.C.B.
1916–18	...	Sir John Anderson, G.C.M.G., K.C.B., LL.D.
1918–23	...	Sir William Henry Manning, G.C.M.G., K.B.E., C.B.

Surveyor-General:

1914–15	...	Mr. R. S. Templeton.
1915–23	...	Mr. W. C. S. Ingles.
1923	...	Mr. A. J. Wickwar.

Deputy Surveyor-General:

1914–15	...	Mr. W. C. S. Ingles.
1915–23	...	Mr. A. J. Wickwar.
1923	...	Mr. A. H. G. Dawson.

Assistant Surveyor-General:

1914–15	...	Mr. A. J. Wickwar.
1915–23	...	Mr. A. H. G. Dawson.
1923	...	Mr. C. R. Lundie.

Organization of the Survey Department.

Field :—

12 Superintendents of Surveys; 1 Superintendent, Colombo Observatory; 37 Assistant Superintendents of Surveys; 2 Astronomers; 280 Grade Surveyors.

Office :—

6 Assistant Superintendents of Survey; 1 Superintendent, Process and Litho. Departments; 1 Instrument Repairer; 1 Accountant; 440 Clerks and Draughtsmen (subsequently reduced to 420).

Topography.—Between 1915 and 1918 some 3,573 square miles were surveyed, which completed the small scale detail survey map of the country. The rate of progress was to some extent adversely affected owing to the retrenchment carried out on account of the war.

Between 1916 and 1923, 11,543 square miles were contoured. Contoured maps were produced in 1919 which were found of great value for commercial and industrial development as well as for military purposes, and are in considerable demand by the public. The Committee desires to record its opinion that the contoured topographical maps, on the scale of one-inch to one mile, are admirable specimens of cartography, and reflect great credit on the Department.

In 1921 and 1922 experiments were made in contouring with the aneroid barometer. Results obtained failed to justify the employment of these instruments.

In 1917 and 1918, Colombo and neighbourhood were specially surveyed for military purposes and coloured maps on the scales of 1 mile and ½ mile to the inch were published.

Triangulation.—In December, 1914, all trigonometrical field work was stopped on financial grounds; but computation and compilation, including the calculations of the Pelmadulla Block Survey Triangulation, were continued. In 1916 and 1917 two minor schemes were completed in the field in connection with the Block Surveys and Pelmadulla Triangulation Scheme, and calculations thereof made. Between 1917 and 1921 only scattered minor triangulation work was carried out and a special triangulation was made for the new survey of Colombo. From 1921 onwards a triangulation was in progress for the survey of the harbour villages in the Trincomali district and some vertical angles were measured from road levels along the west coast of the island.

Some triangulation for block surveys in the Province of Uva was carried out during the last year of the period under review.

Levelling.—After some 47 miles of levelling had been run between Trincomali and Batticoloa during 1914 and 1915 the field work had to be abandoned owing to the war, though the office work was continued.

For the remainder of the period under review no field work was done and office work was confined to supplying information required by other government departments.

Block Surveys (including Settlement Surveys).—During the 10 years under review a staff which gradually diminished from 12 Assistant Superintendents and 120 Surveyors to 1 Assistant Superintendent and 31 Surveyors in 1918, and then increased again to 10 Assistant Superintendents and 80 Surveyors in 1923, were employed on this work.

The progress naturally suffered heavily from retrenchment due to the war, though by 1917 the dislocation of organization had been sufficiently surmounted to enable a very satisfactory rate of progress to be obtained considering the reduced size of the staff.

Up till 1917 the greater part of the staff was employed on Settlement Surveys; after this date a considerable area of Small Scale Forest Survey was undertaken.

During the last two years of the period the greater part of the staff was employed on New Block Survey. During the last year the trace of the Batticoloa–Trincomali Light Railway was surveyed for acquisition over a length of 58 miles through the Block Survey area.

Application Surveys.—A staff varying from 67 in 1914 to about 109 in 1923 was employed on this duty.

The number of questions receiving attention varied from about 3,000 a year in 1914 to 2,290 in 1918, rising again to over 5,000 in 1921.

In 1917 Town Surveys were undertaken of Colombo, Galle Fort, Matura, Trincomali, Kadugannawa and Nawalapitiya.

The survey of the Kirindi Oya Right Bank Scheme, comprising some 7,200 acres, was undertaken for the Irrigation Department.

Survey Department Observatory, Colombo: Meteorology.—Readings were taken daily at 9.30 a.m. and 3.30 p.m. at sixteen meteorological stations. Observations of barometric height, maximum and minimum temperature, wind direction and force, rainfall and weather, were telegraphed every morning to Colombo. Observations were checked, for the most part graphically, at the observatory. The three stations of Colombo, Trincomali and Hambantota reported daily at 7 a.m. to India, and storm warnings were sent out from these stations when required.

The number of raingauge stations sending monthly reports was increased from 231 in 1914 to 310 in 1923. In this work the department received considerable unpaid assistance from planters and others.

An investigation was made of the behaviour of aneroids with change of height. A good series of determinations of error would be well worth publication; a law of error is possibly discoverable.

Seismograph.—Monthly reports were sent to Shide from the readings of the Milne Horizontal Pendulum Instrument.

Time.—Clock star observations for time were kept up and the time ball at the Master Attendant's Office was dropped three times a day at 9 a.m., 1 p.m., and 4 p.m.; excepting during 1918, when the ball was dropped once a day only owing to the curtailment of the staff.

In 1915 a synchronized electric clock was set up at the Colombo wireless station.

Anemobiagraph.—During 1921 one of these instruments was set up at Colombo, and a second one at Haputale, 4,800 feet above sea level.

An Evaporation Gauge was started in 1921 and gave a mean daily evaporation of about 0·22 inches.

Upper Air Work.—In 1920 a start was made on investigations of the upper air strata, and during that and the succeeding years considerable progress was made; so that it is now felt that Ceylon will not be behindhand when compared with other Colonies when called upon to help aviation.

Survey Training School.—The schools at Colombo and Padukka were closed in January, 1915, and remained closed till 1917.

Some twenty surveyors were trained each year for the Department, while numbers varying from three to ten yearly qualified to practise as licensed surveyors.

CYPRUS.

Reports available for all years from 1915 to 1923.

High Commissioner:

1914	...	Major H. Goold-Adams, G.C.M.G., C.B.
1915	...	Major Sir J. E. Clauson, K.C.M.G., C.V.O.
1920	...	Sir Malcolm Stevenson, K.C.M.G.

Registrar-General and Director of Surveys:

1914–17.	...	...	Mr. F. Ongley.
1918–20.	...	...	Mr. C. D. Fenn.
1920–23.	...	...	Mr. B. T. Watts.

Assistant Director of Surveys:

1914–20.	...	...	Mr. B. T. Watts.
1920–23.	...	...	Mr. P. E. L. Gethin.

Organization of the Survey Department (1923).

Field Survey Section :—

4 Surveyors; 3 Assistant Surveyors; 13 Native Surveyors (temporary); 11 Permanent Land Registry Clerks; 59 Chainmen and Staffmen (temporary); 2 Pay Clerks (temporary).

Drawing Office Section :—

2 Surveyors; 16 Permanent Land Registry Clerks; 3 Temporary Clerks; 5 Chainmen (temporary).

There are also Valuation and Land Registration Branches, which are not dealt with in this report.

Trigonometrical Section.—In 1914 the second order triangulation of the island, decided upon the previous year, was in progress. The network consisted of thirteen interlacing polygons, one quadrilateral, and four triangles external to the main polygonal configuration. The average triangular error was approximately 2·24 seconds. The cost of the triangulation worked out at £0·434 per square mile, and the work was completed within the year.

Observations for Azimuth were made at Famagusta.

The Department proceeded with minor triangulation, commencing with the districts of Larnaca, Messaoria and Kyrenia and East Carpas. The districts of Limassol, Nicosia, and Papho were successively taken up for this work during the period under review, the districts of Kyrenia and Limassol being completed by 1916, Limassol in 1917 and Nicosia in 1919. The cost of the minor trigonometrical work varied between the limits of 10*s*. and £2 10*s*. per square mile.

Theodolite and Chain Traverse was conducted as a preliminary to the Detail Survey, some 80 miles being run in the Famagusta District during 1914 at a cost of 0·18*s*. per acre.

Between 1915 and 1918 the Kyrenia District was traversed, three men being employed on this work. Some delay was occasioned at the commencement owing to lack of training of the men employed, but thereafter satisfactory progress was made.

The cost was in the neighbourhood of 0·2*s*. per acre.

Detail Survey.—The survey of the district of Famagusta on the scale of 1/2,500 was continued and completed in 1916, a total area of 69,000 acres being covered at a cost of 1*s*. per acre, *i.e.*, £32 per square mile.

The method by which each surveyor had hitherto surveyed and plotted a definite square irrespective of control points was abandoned in 1916 in favour of a "Block System," where the area given to each surveyor was that enclosed by a system of traverse or otherwise trigonometrically fixed points. Plotting being now done in the office and the area delimited by the control, the results have been found much more satisfactory.

By 1917 about one-third of the Kyrenia district had been surveyed. This survey progressed from east to west, much difficult work being met with on the north and south sides of

the Kyrenia Hills, where the country is rough and intersected with deep and narrow valleys; this work was finally completed in 1920. The total area surveyed was 59,330 acres and the cost for Survey and Examination, £1,639, *i.e.*, 0·55*s*. per acre or £17 14*s*. per square mile.

A considerable number of villages were surveyed throughout the period under consideration on the scale of 1/1,250, first of all in the Larnaca district and later in the districts of Nicosia, Limassol and Papho.

A survey of the town of Limassol on the 1/500 scale was undertaken in 1917; a base of 1,038 feet in length being measured along the sea front from which a triangulation was developed. Town surveys on the scale of 1/500 were also undertaken of Larnaca, Scala, Papho and Ktima.

Topographical Section.—By June, 1914, a sufficient number of triangulation points having been computed in the Larnaca district, plane table work and tachymetry were carried out from west to east on the scale of 1/5,000. Three men were employed on this work at first but the number was raised to seven in 1916. The country was mostly difficult on account of its hilly nature and the number of scattered trees. The cost of this work was about 0·4*s*. per acre or £12 16*s*. per square mile.

By 1918 the survey had extended in some places into the Limassol district, and by the end of that year the Larnaca district had been completed. Work in the Limassol district was continued, where the ground was rough and difficult, the cost varying between 0·36*s*. and 0·64*s*. per acre (£11 10*s*. to £20 2*s*. per square mile); finally this work was completed in 1921.

Work was commenced in the Nicosia district in 1919 and carried on throughout the remainder of the period. The country was flat and survey was simpler. The cost of work in this district was in the neighbourhood of 0·44*s*. per acre (£14 2*s*. per square mile).

On completion of the Limassol district work was started in the Papho district, where the nature of the ground was rough and hilly.

From six to eight surveyors were employed during the periods mentioned in each of these districts. As far as can be judged from the reports as to the nature of the work, £12 to £14 per square mile is not excessive for topography on the scale of 1/5,000 in average country; the relative cost in the Nicosia and Larnaca districts, the former described as flat and easy, the latter as mostly difficult, is explained by the size of the cultivated plots; in the former they average about 1 acre, in the latter 1½ acres.

Computation, Plotting and Drawing, Triangulation.—Before all the major triangulation stations had been occupied it was found expedient to adjust the Famagusta Base extension. This adjustment was disposed of in May, 1914.

The Famagusta and Papho base extensions were adjusted independently of the main network as their introduction into the main adjustment would have rendered the computation unwieldy; spherical excesses were computed to the second decimal place. In carrying out the general adjustment of the main polygonal configuration the " method of angles " was used in preference to the " method of directions." All observations were considered to be of the same weight. The condition equation for the reproduction of bases through the intervening chain was introduced.

The rectangular co-ordinates of stations were computed from the geographical co-ordinates by the formulæ applicable to the rectangular spheroidal (Cassini) projection.

The co-ordinates and azimuths of the points of the minor triangulation were computed in the usual way and adjusted in each triangle by considering the different circuits of the lines of minor order through the vertices of the major triangles and distributing the differences, as in adjusting a traverse.

The co-ordinates of points fixed by resection were calculated with the aid of the Brunsviga machine, which was found invaluable. The plotting of triangulation points was done by the Co-ordinatograph.

2. *Chain Survey.*—The plotting of the chain survey work was carried out by a staff of between four and nine plotters, and two examiners of plotting. The average rate of plotting for a trained plotter was found to be 27 acres per working day.

The calculation of areas was carried out at headquarters by computing-scales and planimeters; at H.Q. also, the fair drawing and typing of plans. It was necessary to make sun-prints of completed plans in order to furnish the Valuation Office with plans before the published copies became available.

Traverse Computations, with very few exceptions, were carried out at H.Q. Theodolite traverses between trigs. for detail survey showed closures of 1/3,800 to 1/1,500 and 5 to 12 seconds per angle. From the traverses numerous points are fixed by intersection and otherwise. The cost is about £1 10*s.* per mile run.

Maps Published.—The following table shows the number of plans on the various scales, published each year :—

Date.	1/500	1/1250	1/2500	1/5000	4 ins. to 1 mile
1914–15 ...	—	17	192	6	29
1915–16 ...	—	47	176	18	7
1916–17 ...	—	—	—	—	—
1917–18 ...	35	16	24	65	—
1918–19 ...	42	29	42	57	9
1919–20 ...	1	13	—	41	—
1920–21 ...	12	37	127	48	—
1921–22 ...	—	2	85	—	—
1922–23 ...	27	8	6	—	—

Plans on the scale of 4 inches to 1 mile show the main natural features which appear on the 1/2,500 plans and are intended chiefly for administrative purposes. Village and forest boundaries are the most important features shown on them. They are reduced from the 1/2,500 plans by Pantograph and Eidograph.

Expenditure.—The total cost of the Department, which includes the Land Registration Branch, has been as follows :—

Year.	*Cost* £
1914–15.	2,850
1915–16.	11,601
1916–17.	12,175
1917–18.	12,146
1918–19.	11,911
1919–20.	12,645
1920–21.	20,008
1921–22.	20,223
1922–23.	19,403

Owing to the different methods of compiling statistics it seems impossible to separate the total costs of survey, of land valuation and land registration. While the statistical details are excellent, even profuse, it would seem desirable to adopt a more systematic arrangement of final groups, to be followed throughout the years.

This Department appears to have grasped the necessity for survey on sound modern lines and its annual output indicates efficiency.

GOLD COAST.

Reports are available for 1919, 1920, 1921, 1922 (*Jan. to Mar.*) *and* 1922–23.

Governor:

Brigadier-General Sir F. G. Guggisberg, K.C.M.G., D.S.O.

Surveyor-General:

June, 1919–Sept. 1920—Major H. A. L. Hall, M.C., R.E.
October, 1920—Lt.-Colonel R. H. Rowe, D.S.O., M.C.

Organization.

The survey was reorganized in 1920 on the following basis :—

1. *Topographical Branch.*
   Director.
   Deputy Director.
   2 Field Sections, each consisting of 2 Field Camps.
   Framework Section, consisting of 2 Trigonometrical and 2 Levelling Camps.

Each Field Section is in charge of a senior officer. The Framework Section was in charge of the Deputy Director; but in 1921 it was converted into a Field Section.

2. *Cadastral Branch.*
   Director.
   Deputy Director.
   4 Provincial Survey Sections, each under a Provincial Surveyor.
   Accra Town Survey.
   Lands and Boundaries Section, under a Superintendent.

3. *Records and Reproduction* with Controller, Superintendent of Maps and Plans and Record Keeper.

4. *Survey School* under Chief Instructor.

Work Done.

Topographical Branch.—There was practically no staff until 1920, and in that year work did not begin seriously until October.

Framework.—In 1920 observation and computations were completed for the main triangulation from Accra to Appam and from Accra to Akuse; while the reconnaissance from Akuse to Coomassie was well advanced. This work provided the topographer with a framework and controlled traverses previously done, so making available an accurate framework for the Cadastral Survey.

In 1921 triangulation was extended further in the Eastern Province and carried to Lake Bosumtwe, from which point a connection was made by traverse to Coomassie. The country traversed was very difficult and heavy cutting was necessary.

In October, 1921, the Framework Section, having completed sufficient framework, became No. 3 Field Section and proceeded to carry out detail survey.

In 1922, during the recess (June—October), a party of one European and two African surveyors carried out 60 miles of theodolite traverse and 190 miles of instrumental levelling, with a detail survey of each route.

Detail Survey.—In 1920 (2½ months), 1,200 square miles were surveyed on the scale of 1/62,500, together with five town plans (provisional surveys pending survey by the Cadastral Branch).

1921.—Three thousand four hundred square miles were completely surveyed and 2,000 approached completion. In October an extra Field Section became available, formed from the Framework Section. Eight N.C.O.'s were in this year replaced by four officers, with the result of a larger output at the same cost. Miscellaneous work consisted of six town plans and a boundary dispute plan.

1922 (January to March).—Five thousand six hundred square miles were surveyed.

1922–23.—Thirty-three completed sheets (about 6,800 square miles) were handed in for publication, and field work on eight more sheets (about 1,650 square miles) was completed. By the end of this year a total of over 17,000 square miles had been surveyed.

Cadastral Branch.—1919.—No field work, as there was no staff. Eight sheets of the Accra Town Survey (Ext. northwards) were drawn and issued as sunprints.

1920.—Work was only beginning this year, owing to lack of native surveyors. Most of the trigonometrical and traverse work of the Accra Town Survey was completed; 3½ square miles of the heaviest detail were finished and 12 miles of levelling.

1921.—Nineteen sheets of the Accra Town Survey (1/1,250) were finished and published. Twenty-eight miscellaneous surveys (including the important Takoradi harbour survey) were carried out, some being still in progress at the end of the year; and eight preliminary surveys for boundary disputes.

1922 (January to March).—Four sheets of the Takoradi survey were published; 22½ miles of traverse completed.

1922–23.—Thirty-eight miscellaneous surveys were carried out, among the most important being the completion of the survey of the Takoradi Harbour lands (30 sheets on 1/1,250), the continuation of the survey of Accra on the same scale and the framework for the new survey of Coomassie.

By the end of the period under review the Cadastral Branch was well established and organized. The Provincial Surveyors, in charge of the Provincial Survey Sections, are regarded as the advisers or staff officers of the Provincial Commissioners in all matters relating to survey work, and in their area they superintend and co-ordinate the work done by Licensed Surveyors.

The system adopted for cadastral maps may be mentioned. The projection chosen is the Transverse Mercator with two standard submeridians. All points are plotted by a single system of co-ordinates referred to an origin to the South-West of the Colony. All plans have their edges parallel to the meridian of 1° West; the necessary tables have been or are being calculated, whereby the geographical are reduced to the rectangular co-ordinates, or *vice versa* by arithmetrical interpolation and the convergence is obtained by inspection.

Records and Reproduction Branch.—The latter part of 1920 and early part of 1921 were largely occupied in organizing this Branch, and carrying out necessary alterations to buildings for its accommodation.

The records of both Cadastral and Topographical work have been put on a systematic footing, and are now thoroughly organized. By the end of March, 1923, thirty-eight field sheets

complete with name lists, boundary books and other records had been indexed and stored. The Place-name Index had been completed for thirty-five sheets. This is a very complete index on the card system, giving details of population, position, markets, trading firms, etc.

Local reproductions of maps and plans began early in 1921. Topographical sheets (1/62,500) were printed in five colours and numerous plans and diagrams issued for Government Departments. Both the helio and vandyke processes are used. The work of reproduction expanded greatly, and in 1922–23 the following maps, etc., were printed, among others :—

13 sheets Accra 1/1,250.
30 sheets Takoradi 1/1,250.
24 sheets 1-inch Topo. map (Prov. series) in five colours.
13 sheets 1-inch Topo. map, five colours.
Colony Hand Book, etc.

The value of maps issued to the public and Government Departments was in this year £2,084. This may be compared with £70 for 1920 and £376 for 1922.

Survey School.— This was opened in April, 1921, under the Chief Instructor, Captain Griffith, with twenty-three pupils, of whom sixteen were selected by examination, and the remainder were nominated from men already in the Survey. In 1922 there were thirty-nine pupils and in the following year forty-one. The first batch of fully trained pupils was due to pass out in 1923.

The general education of pupils on arrival is low, being classed as 7th Standard, but their progress, as soon as they get accustomed to new ideas, is often rapid. While their mental development is backward, many have keen eyesight and clever and steady fingers and show promise of making good observers. While it is still too early to know to what standard pupils will eventually attain, results so far are promising, and it seems likely that the best men will be competent to do all the work required of them in the Survey Department. Great attention is paid to discipline, physical training and sports.

The instruction includes surveying, mathematics and drawing. The topographical work includes levelling, plane tabling and prismatic compass traverses; while in cadastral training, levelling, large scale plane tabling, elementary theodolite work and chaining are taught.

Besides instruction, some research work is carried out. Useful investigations have been made in the behaviour of the aneroid barometer and various tables and pamphlets have been issued on other subjects; in this work the pupils assist.

Details of Costs.—No figures are given in the Reports for total cost, but there is useful information on certain details. It

is noted that the most economical work is done by efficient Europeans who keep fit: sick Europeans send up costs to a quite disproportionate extent.

Generally speaking, costs of survey in this country must always be high owing to the great amount of cutting required together with the difficulties of transport.

Topographical survey, in dense forest, on 1/62,500 *scale.*

Average cost per sheet of 290 sq. m.	£650	0	0
Miles of detail traverse per sheet ... av. 520			
Cost per trav. mile of detail survey...	£1	5	0
Cost per mile, theod. framework traverse	£7	11	0
Cost per mile, instr. levelling by roads or paths ...	£1	14	0
Cost per sq. mile in dense country ... ... up to	£4	0	0

The above figures exclude inspection, checking, preparation for reproduction, and leave, but include all time, even sickness, spent on actual field work.

Cadastral Survey.—The cost is high owing to the dense forest and jungle in which all work is done. In 1921 the average cost of rigorous traverses for boundary surveys was £48 per mile, which is £3 less than the authorized charge. In 1922–23 this was reduced to £35, mainly due to improved methods and greater experience.

Cost of instrumental levelling :—

Dense forest, £12 17*s.* a mile.
Light forest, £5 4*s.* to £5 18*s.* a mile.

High-class compass surveys for preliminary boundary surveys in forest country average £4 8*s.* a mile.

General Remarks.

The chief point to remark on in the Gold Coast Survey is the admirable way in which the whole Survey has been organized and a sound programme laid down. The Colony is much to be congratulated on the enlightened policy adopted in this respect. It is doubtless due in the first instance to the fact that the Governor is himself a distinguished surveyor; but it is obvious that he has been most ably and energetically served by the Surveyor-General, Lt.-Colonel Rowe, and his Directors and Assistants.

Among the valuable features in the general scheme the following may be mentioned. A comprehensive scheme has been laid down for both topographical and cadastral sheet lines. A single system of co-ordinates has been adopted for the whole area. Arrangements have been made, by legislation where necessary, for controlling and co-ordinating all cadastral work whether official or private, so ensuring uniformity of method and a proper location of all plans surveyed. The keynote of the organization of cadastral work is decentralization with co-ordination. Economy has been studied by the development of

local means of reproduction and by the training of native personnel on a sound system. A proper system of records has been established.

The Gold Coast Survey may well be taken as a model by other Colonies and Protectorates whose Surveys are less advanced.

HONGKONG.

Reports available for all years from 1915 *to* 1923.

Governor:
Sir R. E. Stubbs, K.C.M.G.

Director of Public Works:

1914–21	...	...	Mr. W. Chatham, C.M.G.
1921–23	...	...	Mr. T. L. Perkins.
1923 ...	...	...	Mr. H. T. Creasy.

Superintendent of Crown Lands
(formerly Principal Land Surveyor).
Mr. L. C. P. Rees.

Organization of the Survey Department (1923).

The Crown Land Survey Office (until 1922 called The Land Survey Office) forms a branch of the Public Works Department and includes the following staff :—

Field :—

11 European Surveyors; 3 Chinese Assistant Surveyors; 5 Chinese Apprentice Surveyors and a number of Chinese Student Surveyors.

Office :—

1 European Draughtsman; 11 Chinese Draughtsmen; 1 European Clerk; 5 Chinese Clerks; 2 Chinese Computers.

In addition to the above there are 67 Survey Coolies.

Trigonometrical Survey.—The trigonometrical survey of the Colony was extended eastwards by a series of interlacing polygons from Stanley to Wong Ma Kok, Loo Chan Island, D'Aguilar, Waglan, Tung Loon Island, High Junk Peak, and

Hai Wan; five new stations being erected. This work was undertaken in 1915 and closed on the original work with an average angular error of three seconds, which is satisfactory. The area embraced was about 32 square miles.

In 1916 Minor Triangulation work was extended from Stonecutters Island and Mount Davis to Kan Island, Chan Island, Cheung Chan Island, and Lamma Island, and was closed with good results.

No other trigonometrical work was carried out during the period under review.

Topographical and Cadastral Work.—Some 456 miles of traverse were done during the first three years of the period under review, mostly in connection with filling in and carrying out the " Ordnance Survey " of the Colony.* Thereafter lesser distances varying from 30 to 70 miles a year were traversed. Traverse stations were marked in a more permanent fashion than had been done hitherto, as it had been found necessary to re-traverse certain portions in consequence of stations having been dug up or lost,—one more example of reprehensible failure.

In 1914 a main traverse was laid down, marked by concrete traverse points, from Kwan Ti to Tai Po via Fan Ling.

In 1922 main traverses were run from Victoria Orphanage Trigonometrical Station to East Battery Trigonometrical Station, East Battery to Gascoigne Road Trigonometrical Station and Gascoigne Road to Tai Kok Tsui Trigonometrical Station. Main traverse points were defined by picket boxes or monuments which also define centre lines of roads.

Up to 1917 good progress was made with the detail survey of the Colony. After that date the work had to be curtailed owing to the number of men joining His Majesty's Forces. The work was plotted on a scale of 50 feet to 1 inch and reduction made afterwards to the scale of 200 feet to 1 inch as required.

Between 1914 and 1918 a surveyor was continuously employed on the survey of villages in the New Territories.

The Survey of Kowloon was completed in 1917 and the revision of that district, which had been commenced in 1915, was continued.

In 1916 and 1917 a survey was made in connection with the Kowloon Bay Reclamation Scheme, covering some 227 acres, and a considerable amount of work was done on the Shamshinpo Reclamation Scheme between 1918 and 1921. Some small

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* The designation " Ordnance Survey " is probably only intended to imply that the survey is an accurate, official, survey, originally carried out by a military party.

surveys were done in connection with the Reclamation at Cheung Sha Wan. In 1919 some 338 acres were surveyed and plotted at Cheung Chan.

By January, 1920, the European staff had been restored to full strength. Throughout that year and the next the staff was chiefly employed on Application Work and no extensive surveys were undertaken.

In 1922 several extensive surveys were carried out, notably in the areas of Quarry Bay, West Bay, Tytam Bay and Stanley. A survey of cultivation on the Island of Cheung Chan was completed and some laying out schemes prepared for Town Planning.

Numerous surveys were conducted throughout the period of review for sale purposes, fixing boundary stones and surveying lots for Lease Plans.

Maps Published.—The maps of the Kowloon "Ordnance Survey" on the scale of 200 feet to 1 inch were published in 1921.

Cost.—As the Survey Office forms part of the Public Works Department and is accommodated in the same building, the charges for numerous items such as lighting, heating, electric fans, etc., cannot be stated.

Omitting these items the following is a statement of the total cost during each year of the period under review :—

Year.	*Total Cost.*
	$
1914–15	74,569
1915–16	85,494
1916–17	80,056
1917–18	64,765
1918–19	68,773
1919–20	99,16[illegible]
1920–21	102,847
1921–22	120,378
1922–23	139,094

These costs should be separated into the various headings which cover the work of the Survey Branch of the Department.

A recent introduction in the reports contains figures showing the progress and expenditure on individual surveys; but technical details are in general lacking. Thus, no reports can be considered complete without figures as to the closure and cost of traverses, a general indication of the methods of adjusting traverse and triangulation, the rectangular co-ordinate system and its true origin, the fundamental geographical positions and such information of a similar nature as may from time to time assume especial importance.

MAPS OF HONGKONG.

Title of Map.	Scale.	No. of Sheets	Surveyed by	Reproduced by	Place and Date.
Hongkong...	1/15,840 (4 in. to 1 mile).	4	Lt. Collinson (1845) and C.R.E. in China (1895).	Intell. Divn. W.O. (No. 1137 a–d).	London, 1896.
Kowloon (plan)	1/2,500 (25·344 in. to 1 mile).	5	Public Wks. Depart.	E. Stanford (for C.O.).	London, 1901.
Plan of the City of Victoria, Hongkong	1/1,920 (33 in. to 1 mile).	11	Ditto	(Not stated) ...	London, 1901.
Map of Hongkong and of the territory leased to Great Britain under the Convention between Great Britain and China, signed at Peking on the 9th June, 1898.	1/84,480 ($\frac{3}{4}$ in. to 1 mile).	1	Compiled and reproduced by G.S.G.S. (No. 1393)	...	London, 1905. *Addns.* 1922.
Kowloon and part of new territory...	1/7,920 (8 in. to 1 mile).	21	Under superintendence of Major King, R.E. 1902–1903.	O.S.O.	Southampton, 1904. *Under revision.*
*Map of Hongkong and new leased Territory.	1/63,360 (1 in. to 1 mile).	1	Compiled and reproduced by G.S.G.S. (No. 2568)	...	London, 1911.
*Hongkong and part of leased Territory	1/25,344 ($2\frac{1}{2}$ in. to 1 mile).	2	Compiled and reproduced by G.S.G.S. (No. 2667*a*).	...	London, 1913. *Corrections*, 1920.
Map of the Colony of Hongkong, including new Territories.	1/31,680 (2 in. to 1 mile).	12	Public Wks. Depart. ...	O.S.O.	Southampton, 1915. *Under revision.*

* Out of date and to be superseded by revised $\frac{3}{4}$ in. and 2 in. maps.

JAMAICA.

Reports available for all years from 1915 to 1922.

Governor:

1913–18 ... Sir W. H. Manning, K.C.M.G., K.B.E., C.B. 1918 ... Sir Leslie Probyn, K.C.M.G.

Surveyor-General:

1908–18 ... Mr. Colin Liddell, I.S.O. 1921 ... Mr. A. E. Young.
1922 ... Mr. W. Anthony Baker, F.S.I.

1. The following are the particulars of Staff, Expenditure and Revenue (to nearest £50), with some details as to Traversing. It is to be noted that from December 31st, 1920, the financial year coincides with the civil year.

Year.	Staff.								Expenditure.			Revenue.	Traverses.		
	Surveyor-General.	Actg. Surv.-General.	Surveyors.	Assistant Surveyors.	Temporary Surveyors.	Draughtsmen, Tracers and Copyists.	Clerical Staff.	Total.	£ Personal Emoluments.	£ Other Charges.	£ Total.	£ (derived from sales of land and lumber, rents, etc.)	Miles Run.	Cost per mile. *Shillings.*	Daily Progress in Chains.
1914–5 ...	1	—	—	1	3	2	3	10	2,900	1,250	4,150	5,050	266	50—86	80—45
5–6 ...	1	—	—	1	3	1	2	8	2,900	700	3,600	5,600	234	40—86	90—50
6–7 ...	1	—	—	1	3	1	2	8	2,550	600	3,150	6,200	162	80	40
7–8 ...	(1)	—	—	3	1	1	4	10	2,250	750	3,000	4,800	213	80	40
8–9 ...	—	1	—	2	1	—	4	8	2,250	1,100	3,350	5,550	77	85	40
9–20 ...	—	1	—	1	1	—	6	9	2,450	700	3,150	6,200	60	90	40
1920 ...	—	1	—	1	—	—	6	8	2,021	—	4,000	(7,400)	29	140	40
1 ...	1	—	2	2	—	—	?	?	3,984	959	4,944	6,500	21	217	35
2 ...	1	—	2	—	?	?	?	?	3,613	1,044	4,657	6,200	48	134	40

To complete this table and preserve continuity, the missing figures should be supplied with the 1923 report.

JAMAICA.

(*See also* p. 65.)

Owing to the hurricane of September, 1917, and the shortage of timber caused by the war, it was decided to develop the timber resources of the Crown Lands. This accounts for the increase in expenses in 1918–19; it is remarked that it was difficult to obtain labour at remunerative rates, a considerable rise over pre-war wages being demanded. The lumber was required principally for hardwood sleepers, posts for wire fences, bridge timbers, roofing shingles, scantlings and boards—the two latter especially in the initial period. The chief elements of expense included under other charges are: (1) cutting lumber; (2) travelling expenses; (3) wages of labourers attending surveys; (4) surveying lands for small settlers; (5) construction and maintenance of roads, etc., on Crown Lands.

The mileage of traversing is significant. Even after making allowance for increase in wages, the figures prove that as the mileage diminishes, the cost per mile increases disproportionately. They indicate, moreover, that during the period under review the Survey Department had become more and more a Land Record Office. This statement is verified by the remark in the 1922 report that, whereas three surveyors were available for field work up to October, 1916, in 1922 one only was available.

The field duties of the Department involve the survey of lands purchased by or escheated to the Crown; of land sold by the Crown; of land recovered from squatters or forfeited for non-payment of taxes; and the delimitation of Crown Lands which are coterminous with private properties. The surveys are apparently all closed traverses, with linear errors of from 1 in 400 to 1 in 1,400; the cost of cutting boundaries through bush is about £6 per mile at the speed of a half-mile per day.

Since there is no framework of survey in the Colony, these traverses are generally disconnected. If then the boundary marks are not permanent, the Crown in future years will be put to considerable expense in establishing its rights in all cases, particularly if the field work is, as at present, reduced to a point below minimum. If the surveys of private properties, executed by Licensed Surveyors, were in all cases dependable, there might not be much to fear in this matter, especially as the Department employs 40 Bailiffs and 75 Headmen to supervise the administration of the Crown Lands, amounting in all to 280,000 acres or about 440 square miles. But it is obvious that, if 45 per cent. of the plans of private properties have to be referred back to the surveyors on the grounds of inaccuracy, the situation is far from being satisfactory.

These remarks apply to the Crown Lands only, that is to say, to a small fraction of the island content. The State is equally interested in the rights of its citizens to the undisturbed occupation or possession of the lands to which they are entitled.

2. *Land Records.*—In the two tables following are collected the records of sale, lease, tenancy, forfeiture, examination and registration of title and so forth.

Year.	Land Purchased.				Applications to Purchase.			
	Outright.		Instalment.		Made.		Allotted.	
	No.	*Acres.*	No.	*Acres.*	No.	*Acres.*	No.	*Acres.*
1914–15	53	193	314	2,881	70	538	35	216
1915–16	49	160	128	1,138	575	4,363	253	2,100
1916–17	84	1,093	85	841	251	2,023	424	4,200
1917–18	29	117	26	292	126	1,473	84	1,278
1918–19	37	169	26	220	241	2,449	114	1,308
1919–20	121	880	28	253	185	1,910	70	1,011
1920	59	4,396	12	84	84	1,046	40	968
1921	46	367	17	144	52	645	26	365
1922	39	347	32	242	58	785	60	808

The lands purchased by instalment come under the Rules for the Sale of Crown Lands to Small Settlers, which had been suspended for a few years prior to December, 1914. Progress was checked in 1917 owing to the lack of money consequent on the war and the hurricane of August, 1916. In 1922 it is noted that 814 warning notices had to be served on instalment purchasers.

Year.	Leases and Tenancies.				Forfeiture.		Escheats and Squatters.	Records.		Registration.	
	No.	*Acres.*	Town Lots.	Predial No.	Pending *Acres.*	Decreed *Acres.*		Deeds recd.	Titles issued.	Diagrams.	Examinations.
1914–15 ...	14	52	12	865	9,450	1,750	—	94	17	627	328
1915–16 ...	23	55	17	811	12,800	1,700	3	74	41	418	649
1916–17 ...	15	7,550*	9	—	12,800	—	1	45	85	358	349
1917–18 ...	18	41	4	396	11,350	1,450	2	40	29	289	260
1918–19 ...	14	1,772	10	663	11,350	—	4	78	16	283	261
1919–20 ...	20	1,205	20	342	11,350	—	—	46	32	267	245
1920 ...	21	6,226	16	585	11,350	—	—	68	21	334	386
1921 ...	21	—	16	680	11,350	(2,470)	—	72	17	434	373
1922 ...	11	1,202	7	928	11,350	(2,580)	—	51	45	423	444

* Of the 7,550 acres leased in 1916–17, 6,400 were in a morass where mangrove bark was being worked.

The predial tenants give considerable trouble: as they frequently grow a catch-crop on the ground and depart immediately after harvesting it, the bailiff has much to do in keeping track of their migrations and much of the rent is irrecoverable.

The outstanding cases of forfeiture merit attention. If the facilities and powers at the disposal of the Survey Department are insufficient to deal with the present and recurrent arrears, it is desirable that its powers should be strengthened.

Possibly the most important, as also the most onerous, duty of the Department consists in the examination of the plans prepared by Licensed Surveyors for deposition, as required for Registration of Title. It is understood that the inefficacy of the present rules in the prevention of abuses is at present the subject of investigation.

Of the 48,100 acres sold since 1897, full payment has been made for 35,900 acres, about 2,000 acres have reverted to the Crown for failure to pay, and instalments and arrears on 10,200 acres are still outstanding on credit. From January, 1897, to January, 1922, about £50,250 had been received from the sale of lands.

3. *Maps.*—In 1914 a general map on the scale of 1 in./1 m. was being undertaken by Mr. Liddell; after £600 had been spent, it was decreed in 1915 that expenditure must cease.

Work on a special map of the Liguanea Plain—scale 5 chains/1 in.—was suspended in 1918–19 and no statement appears as to its completion.

Four Index Maps of the City of Kingston were prepared during the period and one cadastral sheet was copied.

There is a fluctuating demand for maps such as cannot usually be supplied.

4. *General Notes.*—No trigonometrical survey or main traverse system has ever been undertaken by the Department.

The amount of topographical survey executed by the Island Authorities is almost negligible.

Land Boards were set up during the period to advise the Government on the development of the Crown Lands and the construction and maintenance of roads therein. These Boards might conceivably prove themselves of much value.

The Blue Mountain Forest Reserve, which was taken over in 1914, had not been established in 1923 for lack of funds and surveyors.

An attempt to settle men of the disbanded British West Indian Regiment on the land proved abortive.

A dispute pending since 1898, between the Crown and a private owner, was settled in 1918, the former making a payment of £50.

It is significant that the clerical work of the Department has nearly doubled in twelve years.

5. *Remarks.*—The reports prepared by the various Surveyors-General are full, straightforward and commendably continuous. Nevertheless, it is now clear that the form adopted requires re-editing. The work of the Department is divisible into three main branches : (1) Survey ; (2) Land Records ; (3) Crown Lands Development. The preamble and the report generally should be set out under these three headings and the expenditure and revenue ought to be apportioned accordingly. While continuity is commendable, it should be understood that the mere repetition of phraseology is likely to defeat its own object. The work of the Department is often beset with difficulties : the fact that there are arrears of work dating back twenty years would be itself a sufficient indication were other causes not clearly discernible.

KENYA.

Reports available for all years from 1914 *to* 1921.

Governor :

1914–17	...	Sir H. C. Belfield, K.C.M.G.
1919–22	...	Sir E. Northey, K.C.M.G., C.B.

Director of Surveys :

1914 ...	...	Capt. G. C. Williams, R.E.
1915–18	...	Major L. N. F. I. King, R.E.

Deputy Director of Surveys, Trig. and Topo. Branch :

1914 ...	...	Capt. A. M. Coode, R.E.
1915–20	...	Major H. N. Kempthorne, D.S.O.

Deputy Director of Surveys, Cadastral Branch :

1914–21	...	Mr. A. E. Townsend.

Reorganization, 1*st April,* 1921, *as Department of Lands.*

Commissioner of Lands :
Mr. H. T. Martin.

Director of Land Surveys :
Mr. A. E. Townsend.

Assistant Director of Land Surveys :
Mr. T. H. Galbraith, M.C.

Table I.

Organization.

	Year ending 31st March. 1914.	1915–19.	1920–21.
General Superintending Staff ...	3	3	—
Trig. and Topo. Directors	3	2	2
,, ,, ,, Surveyors ...	6	6	3
,, ,, ,, Draughtsman-Clerk	—	—	1
Cadastral Directors	2	2	2
,, Clerks	5	6	6
,, Surveyors (graded) ...	26	31	31
,, Indian Surveyors ...	3	3	3
,, Native ,, ...	2	1	1
Computing Office	7	12	12
Drawing Office—European ...	7	9	9
,, ,, —Indian	6	5	5
Total	70	80	75

Table II.

Comparative Annual Statement of Triangulation.
Year ending 31st March.

	Major Triangles. No.	Average Triangular Error. *Seconds.*	Area. *Sq. Miles.*	Minor Triangles. No.	Average Triangular Error. *Seconds.*	Area. *Sq. Miles.*
1913 ...	55	2·72	8,209	26	3·72	1,323
1914 ...	63	2·16	7,823	39	2·79	2,360
1915 ...	7	2·30	778	1	1·48	55
1916 ...	—	—	—	—	—	—
1917 ...	—	—	—	—	—	—
1918 ...	—	—	—	—	—	—
1919 ...	—	—	—	—	—	—
1920 ...	—	2·10 1·63	1,770	—	—	—
1921 ...	—	—	—	—	—	—

Table III.

Comparative Annual Statement of Topography.
Year ending 31st March.

	SCALE. 1 : 62,500 *Sq. Miles.*	1 : 125,000. *Sq. Miles.*	1 : 250,000. *Sq. Miles.*
1913 ...	—	1,188	10,500
1914 ...	—	1,680	8,000
1915 ...	—	—	1,500
1916 ...	—	—	—
1917 ...	—	—	—
1918 ...	—	—	—
1919 ...	—	—	—
1920 ...	100	—	—
1921 ...	—	—	—

TABLE IV.

Details of Cadastral Survey for Years ending 31st March.

Description.		1914.	1915.	1916.	1917.	1918.	1919.	1921.
Agricultural and Grazing Farms and Mining Concessions	No. ...	509	370	34	62	11	—	21
	Acres ...	1,180,676	1,461,489	112,241	170,507	44,062	—	27,111
Agricultural and Grazing Farms and Mining Concessions (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	90	285
	Acres ...	—	—	—	—	—	67,568	367,968
Reserves	No. ...	33	41	16	20	2	—	3
	Acres ...	15,789	23,355	2,752	6,132	348	—	1,383
Reserves (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	—	—
	Acres ...	—	—	—	—	—	—	—
Re-Surveys	No. ...	145	169	168	61	8	4	11
	Acres ...	96,859	261,248	188,693	60,248	11,405	1,010	19,417
Re-Surveys (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	1	3
	Acres ...	—	—	—	—	—	3,000	1,883
Road Surveys	No. ...	14	7	18	4	—	—	12
	Acres ...	262	250	182	5	—	—	(55 miles)
Road Surveys (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	—	2
	Acres ...	—	—	—	—	—	—	(3 miles)
Forest Surveys	No. ...	3	3	—	—	—	—	1
	Acres ...	89,396	3,339	—	—	—	—	50
Check Surveys	No. ...	3	3	—	26	—	—	2
	Acres ...	5,626	—	—	—	—	—	—
Township Plots and Reserves (1921)...	No. ...	481	120	51	820	18	84	3
	Acres ...	423	158	437	683	58	69	5,446
Township Plots and Reserves (1921)(Private Surveys by Licensed Surveyors) ...	No. ...	—	—	—	—	49	43	1
	Acres ...	—	—	—	—	643	193	1,096
Sub-division of Township Plots ...	No. ...	271	24	310	1,216	4	—	94
	Acres ...	1,291	76	285	326	4	—	67

Sub-division of Township Plots (Private Surveys by Licensed Surveyors) ...	No. ...	—	—	—	—	365	35	135
	Acres ...	—	—	—	—	53	57	344
Township Contour Surveys	No. ...	6	2	6	3	1	2	—
	Acres ...	1,663	366	921	317	280	880	—
Sub-division of Farms...	No. ...	144	169	399	138	122	2	556
	Acres ...	177,071	167,743	85,094	77,743	110,978	360	562,716
Coast Land Surveys, Malindi Shambas	No. ...	238	188	56	—	6	—	—
	Acres ...	10,440	11,317	9,829	—	298	—	—
Coast Land Surveys, Reserves ...	No. ...	6	—	—	2	—	23	11
	Acres ...	17,701	—	—	156	—	7,050	10,262
Coast Land Surveys, Demarcations...	No. ...	137	132	824	689	162	483	830
	Acres ...	10,562	24,633	13,781	5,883	965	11,308	7,852
Coast Land Surveys, Mombasa Island	No. ...	55	129	97	80	48	57	315
	Acres ...	554	365	519	311	69	62	70
Coast Land Surveys, Mombasa Island (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	31	62
	Acres ...	—	—	—	—	—	8	55
Coast Land Surveys, Mombasa Mainland, North	No. ...	—	—	—	—	30	302	655
	Acres ...	—	—	—	—	208	3,744	8,001
Coast Land Surveys, Mombasa Mainland, North (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	—	104
	Acres ...	—	—	—	—	—	—	361
Coast Land Surveys, Mombasa Mainland, South	No. ...	—	—	2	—	493	—	1
	Acres ...	—	—	112	—	1,884	—	61,000
Coast Land Surveys, Mombasa Mainland, South (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	—	—
	Acres ...	—	—	—	—	—	—	—
Coast Land Surveys, Tanaland ...	No. ...	—	—	26	318	—	190	—
	Acres ...	—	—	129	1,082	—	1,074	—
Coast Land Surveys, Jubaland ...	No. ...	—	—	2	1	—	—	—
	Acres ...	—	—	17	14,772	—	—	—
Sub-division of Farms (Private Surveys by Licensed Surveyors)	No. ...	—	—	—	—	—	—	45
	Acres ...	—	—	—	—	—	—	70,908

TABLE V.

Comparative Annual Statement of Cadastral Surveys.
Year ending 31st March.

	Surveys Finished.		Surveys Ordered but not finished.
	Number.	Acres.	Acres.
1914 ...	2,045	1,608,313	2,456,475
1915 ...	1,357	1,954,339	1,826,253
1916 ...	2,009	414,992	1,478,261
1917 ...	3,440	338,165	1,177,095
1918 ...	783	59,581	1,117,514
1919 ...	1,147	25,557	—
1920 ...	—	—	—
1921 ...	2,572	789,338	—

TABLE VI.

Comparative Annual Statement of Expenditure and Revenue.
Year ending 31st March.

	Trigonometrical and Topographical Branch.		Cadastral Branch.		Revenue.
	Estimated.	*Spent.*	*Estimated.*	*Spent.*	
	£	£	£	£	£
1914 ...	8,291	7,868	24,105	24,873	4,922
1915 ...	8,943	5,207	35,090	27,423	1,145
1916 ...	6,984	3,793	31,181	25,110	386

	Survey Department.		
	Estimated.	*Spent.*	
	£	£	£
1917 ...	40,305	27,956	435
1918 ...	39,483	19,780	117
1919 ...	36,887	21,400	618

	Estimated.	*Spent.*	*Estimated.*	*Spent.*	
	£	£	£	£	£
1920 ...	—	2,830	—	—	—
1921 ...	—	—	—	—	2,374

TABLE VIA.

Detail of Revenue.
Year ending 31st March.

	1914.	1915.	1916.	1917.	1918.	1919.	1921.
	£	£	£	£	£	£	£
Survey Fees	4,739	1,013	330	316	—	323	1,369
Sale of Maps	164	116	51	103	97	267	610
Sale of W.O. Maps ...	19	16	5	16	20	28	82
Miscellaneous	—	—	—	—	—	—	313
Total	4,922	1,145	386	435	117	618	2,374

TABLE VII.

Comparative Annual Statement of Cost of Survey.

Year ending 31st March.

	Triangulation Shillings per sq. m.	Topography Shillings per sq. m.	Cadastral Survey Pence per acre.
1914 ...	7·2	10·4	6·06
1915 ...	5·9	—	5·15
1916 ...	—	—	12·18
1917 ...	—	—	11·60
1918 ...	—	—	79·75
1919 ...	—	—	201·60
1920 ...	—	—	15·60
1921 ...	—	—	—

SUMMARY OF WORK DONE SINCE 1ST APRIL, 1914.

I.—*Trigonometrical and Topographical Branch.*

On the declaration of war in August, 1914, the Director of Surveys and all military members of the Branch were ordered to mobilize and their services were henceforth for the most part lost to the Department. At the end of July, 1914, the topography of Sheet S.A.36/F was half completed; but the schemes for the running of lines of precise levels along the Juba River from Kismayu, the remeasurement of the Italian base in Italian Somaliland and the extension of the Italian triangulation of 1912 could not be carried out.

The large saving over the estimated expenditure for the year ending 31st March, 1915, is due to the payment of most of the members of the Branch from military votes during the latter half of this period.

No further work was done until the spring of 1919, when major and minor triangulation were carried out in the following areas :—

(i) On the Voi-Tanga Railway as far as Taveta, connecting with the original Anglo-German Boundary, and thus affording an opportunity of investigating hitherto unexplained errors and of recomputing completely this boundary work.

(ii) In the Teita Hills, to provide a control for a large scale map.

One hundred square miles of topography, on a scale of approx. 1 in. to 1 mile, equivalent to half the survey required, were completed in the region of the Teita Hills, in view of the preparation of a geological map of this area.

Recompilation of the Northern Frontier District continued, considerable assistance being afforded by Political and King's African Rifles Officers.

A compilation of the area covered by Mount Kenya and its peaks above the forest line has been made, principally derived from the observations made by Dr. Arthur during his ascent in 1920.

Map Publications :—

(*a*) The Turkana Sheet, N.A.36/M & F, N.A.37/W & X, scale 1/500,000, has been lithographed at the War Office.

(*b*) The newly compiled sheets of the Northern Frontier District, on a scale of 1/500,000, have been traced as revised and blue prints issued to all concerned.

During the war the six invar 24-metre wires of the Base Measuring Apparatus were sent to the Survey of Egypt for report on standardization; the report has been received.

This branch was closed down on 31st March, 1921.

Kenya is covered by the post-war series of maps published by the War Office : G.S.G.S. 2465, scale 1/1,000,000, and G.S.G.S. 2871, scale 1/2,000,000. There are also areas of the Colony covered by War Office maps of varying dates on the 1/250,000 and 1/500,000 scales.

Much of the work between 1919 and 1921 was due to the initiative and enterprise of Major H. N. Kempthorne, whose death, after leaving the Colony, is much to be regretted.

II.—*Cadastral Branch.*

In 1914 many members of the survey staff volunteered for service in East Africa and others, while home on leave, for service in Europe; the output of work was correspondingly retarded. A large amount was done in the drawing office for the Military Authorities.

During the period 1915–16 a R.E. Lithographic Section arrived from India and relieved the drawing office of much of the military work.

In 1916–17 almost all survey work had to be suspended owing to demands made by the Military Authorities for men for the King's African Rifles, Transport and other branches; work of a very urgent nature only was undertaken.

Considerable trouble has been caused in many parts during the last few years by the frequency with which boundary marks have been displaced or removed by the public and even by the Public Works Department. Deed plan work has been kept up-to-date at the expense of that of other natures, and the requirements of the Military monopolised until the end of the war the greater part of the output of the drawing office. The Clerical Branch became at the same time practically non-existent through the demands of military service.

The need has become very much felt for an ordinance restricting the type of person authorized to carry out land surveys, and for a Standard Survey of Nairobi to clear up all doubts as to the boundaries of properties and to prevent further encroachment.

In 1920 the "Cadastral Branch" was converted into the "Land Survey Branch," and was separated from the "Trigonometrical and Topographical Branch." All the available field staff were employed in subdividing unalienated farms for ex-soldier settlers. In the Coastal districts the Land Titles Survey proceeded steadily; but the unhealthiness of the region caused the death of Mr. E. W. Nelson from blackwater fever, two others at the same time contracting it but recovering. There was now not a sound surveyor in the Department, chiefly owing to long exposure in bad climates without leave to Europe.

1921.—Considerable delay having arisen in the past with regard to the layout of townships owing to the number of authorities to be consulted and the diversity of their opinions, entailing a loss in revenue of thousands of pounds and the holding up of the development of the Colony, it was suggested that the solution of the difficulty lay in leaving the matter in the hands of the Commissioner of Lands and the Principal Medical Officer.

The recent alterations to the Provincial, District and Native Reserve boundaries caused a large number of maps to be prepared for the different administrative officers concerned.

The close of 1921 is coincident with the close of a definite phase in the development of this department. Two years before, an amalgamation of some five hitherto separate departments took place, with a view to immediate co-operation and ultimate economy. It was desirable to draw together, for instance, the examining branch of the Survey Department and the Registry of Titles, in order that surveys generally should be under the immediate control of the chief departmental land authority, and that the respective duties of certain senior surveyors, Assistant Land Officers and Land Rangers should be compared, with a view to their possible redistribution; this particularly in view of the amount of work to be performed in giving effect to the Soldier Settlement Scheme and of the increasing recurrent duties of the Department in administering the local land laws.

The final scheme is as follows :—

Final Reorganization Scheme adopted in 1922.

Commissioner of Lands Office.

Commissioner of Lands	1	Typist	1
Director of Surveys	1	Land Assistant	1

Mines Office.

Land Assistant	1

Titles Office.

Principal Registrar	1	Indian Draughtsmen	2
Registrars	2	Map Record Clerk	1
Chief Computer	1	Printer	1
Chief Draughtsman	1	European Clerk	1
Computers	9	Lady Clerk	1
Draughtsmen	5	Asiatic Clerks	9

District Land Office, Mombasa.

District Surveyor	 1	Asiatic Clerk	... ...		1

District Land Office. Nairobi.

District Surveyor	 1	European Clerk	... ...		1
Land Assistant	 1	Typists ...	... ...		2

District Land Office, Nakuru.

District Surveyor	 1	European Clerk	... ...		1
Land Assistant	 1	Tracer Clerk	... ...		1

District Land Office, Eldoret.

District Surveyor	 1	European Clerk	... ...		1
Land Assistant	 1	Tracer Clerk	... ...		1

District Land Office, Nyeri.

District Surveyor	 1	European Clerk	... ...		1
Land Assistant	 1	Tracer Clerk	... ...		1

Relief District Surveyor ... 1

STRAITS SETTLEMENTS.

Reports are available for 1918, 1919, 1921, 1922.

Governor:

1911–19 ... Sir A. H. Young, G.C.M.G., K.B.E.
1919 ... Sir L. N. Guillemard, K.C.B.

Surveyor-General:

1918 ... Mr. C. G. May (Acting Colonial Engineer and Surveyor-General).
1919 ... Mr. F. J. Pigott (Colonial Engineer and Surveyor-General).
1920 *et seq.* Surveyor-General of F.M.S., *q.v.*

Organization.—The only organization prior to incorporation in the F.M.S. Survey appears to have been a small staff of surveyors, draftsmen, etc., in each of the three Settlements, Singapore, Penang, etc., and Malacca.

In 1918, a Commission of Enquiry was held to report on the adequacy of the staff and to make recommendations. As a result the Department was reorganized on lines similar to those of the F.M.S. Survey.

In 1920, the Survey Departments of the Federated Malay States and Straits Settlements were amalgamated.

Field work is divided as follows:—

(*a*) Control Traverses.

(*b*) Applications (Surveys of land under alienation).

(*c*) Sub-divisions (Requisitions for sub-division of alienated land).

(*d*) Re-surveys of alienated land.

(*e*) Miscellaneous (Roads, Reserves, Areas in dispute, etc.).

Work done.—The work of demarcating and traversing proceeded annually. The staff, which was much below establishment, was inadequate to cope with the requisitions under heads (*c*), (*d*) and (*e*) and the records show a gradual accumulation of arrears.

In 1920, when the Survey was taken over by the F.M.S., the first work done was to train the existing staff in the duties of their appointment. The triangulation of the Peninsula was extended to the Straits Settlements to serve as a control for traverses. In Singapore and Penang the progress in dealing with requisitions was remarkable and arrears were greatly reduced. In Malacca, the largest and oldest Settlement, the state of the survey and of the Office records is such that little progress can be made until an entire re-survey is instituted. A start was made with the 4-inch to the mile survey of Singapore Island; and certain other topographical surveys were carried out.

In 1922 standard traverses were carried out in Malacca by the F.M.S. Trigonometrical Branch, while in Singapore and Penang the control work was done by the Revenue Branch for themselves. 134 square miles of the 4-inch survey of Singapore Island were completed, besides other topographical surveys. Arrears in requisitions were largely reduced.

Cost. ($=2s. 4d.)

Year.	*Gross Cost.*	*Revenue.*	*Net Cost.*
	$	$	$
1918	119,195	44,209	74,986
1919	147,586	44,643	102,943
1920	245,049	41,972	204,077
1921	380,666	47,470	333,196*
1922	422,823	54,306	368,517*

* Includes sums paid to F.M.S. Survey.

General Remarks.—The amalgamation of the Straits Settlements Survey with that of the F.M.S. has resulted, as might have been expected, in a remarkable increase of efficiency. The Department is now properly organized and a regular programme of work is being carried out.

FEDERATED MALAY STATES.

Complete reports are available from 1914 *to* 1922.

General.

High Commissioner:

1914–19 ... Sir A. H. Young, G.C.M.G., K.B.E.
1920 ... Sir L. N. Guillemard, K.C.B., K.C.M.G.

Surveyor-General:

1914–19 ... Colonel H. M. Jackson (Mr. J. P. Harper acting).*
8–3–19 to 30–6–20 ... Mr. J. P. Harper.
1–7–20 to 25–7–22 ... Mr. C. M. Goodyear.
From 26–7–22 ... ... Mr. V. A. Lowinger.

* Colonel Jackson was absent on active service and leave until 7th March, 1919, when he retired.

Organization and Establishment.—The Survey is organized as follows :—

Headquarters (Administrative Office, Central Drawing Office, Photo-Litho Section, Instrument Repairing Section, Technical School).
Trigonometrical Branch.
Topographical Branch.
Revenue Surveys.

In addition, until November, 1914, a Colonial Survey Section was attached.

The Establishment in 1914 comprised 88 Europeans, of whom about 70 appear to have been field staff.

The number actually employed in the field during the period 1914–22 averaged 41 Europeans and 115 others. The Europeans varied as follows :—Trigonometrical, 9 in 1914 to 2 in 1917–19 and 1 in 1922. Topographical, 5 in 1914 to 2 in 1916–20. Revenue Surveys, 55 in 1914 to about 30 during war and 20 in 1922.

Straits Settlements.—In 1920 the F.M.S. Survey took over the Straits Settlements Survey.

Work Done.

Trigonometrical.—In 1914, before the outbreak of war, the Kelantan triangulation had been completed and connected with that of Upper Perak. The programme of precise levelling was almost completed. Secondary triangulation was being carried on in Upper Perak for topographical purposes. On the general reduction of expenditure in August work was confined to certain base measurements and other work required for the revision of the primary triangulation.

In 1915 three base lines were measured and some triangulation carried on for topography. From 1916 to 1920 work was very limited. A small amount of revision was done and some standard traverses and levelling. Tide gauges at Port Dickson and Port Swettenham were kept going.

In 1921 the staff were occupied mainly in the Straits Settlements, completing the triangulation and running traverses for the control of the Revenue Surveys. One thousand two hundred square miles of topographical reconnaissance was carried out in Pahang and 132 miles of levelling were completed. In 1922 work was again limited; in the Straits Settlements traversing was continued.

Details of Cost.—The discontinuity of work during the war make cost returns for the most part of no value. In 1914 it is noted that precise levelling cost $37·8 per mile, a reduction on the previous year. The Kelantan triangulation cost $435 per station of observation, a reasonable figure in view of the difficulties.

Topographical.—In 1914 the Topographical Branch was occupied mainly in Perak and the Colonial Survey Section in the Negri Sembilan. The work in Upper Perak proved very difficult and only half a sheet (about 140 square miles) was completed, together with over 600 square miles in Lower Perak. In Negri Sembilan the field work (by the Colonial Survey Section) of four sheets was well in hand when work stopped in August. After this topographers were employed mainly on special surveys for war purposes.

During 1915 the civilian Topographical Staff was kept up to strength, and this, combined with increased efficiency, resulted in the survey of 888 square miles, the largest output since 1909.

In the seven years 1916–22, 2,143 square miles of the 1-inch map were surveyed, the amount done in each year varying considerably. From 1916–20 337 square miles of the 4-inch map (Forest Reserves) were surveyed. Besides this, work on other scales and many special surveys were executed.

In 1922 134 square miles of the 4-in. to 1-mile map of the Island of Singapore were surveyed.

Details of Cost and Progress.—As with Trigonometrical work, the exceptional conditions made cost returns of little use for purposes of comparison.

As illustrating the wide differences of cost according to the country surveyed and the consequent difficulty of estimating, the following figures are given for work done in 1914. Cost in $ per square mile for 1-in. to the mile survey.

	Field Work.	*Gross Cost.*
N. Perak, very difficult country ...	56·33	144·33
Coastal sheets, easy country ...	13·29	24·82

The cost of the 1-in. work done by the Colonial Survey Section in Negri Sembilan was, for field work only, $56 per square mile.

In 1915 work on the same scale by the Topographical Branch, partly in Upper Perak and partly in Kinta, Batang Padang and Lower Perak, is reported as costing (in all) $62 per square mile, and in 1918 $84. In 1919 total cost went up to the abnormal figure of $147, although the output per man per month was then 4·96 square miles, as compared with 4·80 in 1918.

Figures for 4-in. survey are :—

1918.—Cost per square mile, $286; output per man, — square miles per month.

1919.—Cost per square mile, $423–6; output per man, 1·00–1·67 square miles per month.

1920.—Cost per square mile, $576; output per man, 1·00 square miles per month.

1922.—Cost per square mile, $418; output per man, 1·29 square miles per month.

The figures for 1920 and 1922 include bonus. The great increase in cost is ascribed to special expenses, free issue of rice, abnormal sickness, etc.

Revenue Surveys.—The following statement gives the acreage and cost of surveys carried out in the period under review, together with that of the two previous years for comparison. It should be noted that in 1919 revised salaries came into force; cost from that date is therefore not directly comparable with that of previous years.

For 1921 and 1922 the form of report is altered and information is incomplete.

Year.	Surveys of Agricultural, Mining and Native Holdings.				All Surveys.			Total Cost.
	Lots.	Acres.	Cost per Acre.	Cost.	Acres.	Chains.	Cost per Chain.	
			$	$			$	$
1912	15,502	180,156	1·48	266,422	264,810	642,001	0·64	412,323
1913	17,046	147,192	1·88	276,226	270,375	663,958	·70	464,215
1914	13,171	98,999	1·98	195,998	170,564	538,492	·67	365,911
1915	13,809	84,968	2·15	182,803	114,822	476,642	·69	330,333
1916	16,595	159,505	1·60	258,231	162,085	505,801	·68	347,517
1917	18,086	161,774	1·70	275,234	169,520	479,773	·74	353,226
1918	18,983	149,279	1·90	282,984	163,818	500,762	·75	375,651
1919	13,153	82,590	2·70	223,351	169,689	440,010	·86	378,576
1920	12,209	153,711	2·22	227,807	153,711	380,906	1·02	389,152
1921	15,741	—	—	—	119,381	478,731	0·88	422,335
1922	—	—	—	—	212,278	—	—	—

Requisitions for Surveys.—These form a useful index of the volume of work received by this Branch, and of how it is dealt with; but unfortunately the figures dealing with them are incomplete. While detailed figures are given for three provinces, those

for Pahang are only furnished in part. It is evident, however, that while there were large accumulations of this work during the war and just after, the arrears are now gradually being overtaken. For example, excluding Pahang, the unsatisfied requisitions at the end of 1915 amounted to 16,921; in 1917 they numbered 35,276; while by the end of 1922 the total for all provinces was 27,516. The requisitions awaiting survey had by this date been reduced to about 10,000, but the arrears in the Office were greater. The arrears are chiefly due to requisitions for small holdings.

Standard of Work.—First class surveys in ordinary country: Limit of error for standard traverse—bearing 1¼ minutes for 25 stations, with linear error of 1 link in 80 chains. Second class surveys: 2½ minutes and 1 link in 40 chains.

Central Drawing Office and Photo-litho Section.—In 1914 9 sheets of the 1-in. map and a general map—12 miles to 1-in.—were published in colours, with 30 town plans, 123 revenue survey maps and numerous miscellaneous maps, plans, etc. After August, 1914, these branches were employed mainly on miscellaneous work connected with the war, but geographical and survey work was not altogether dropped. In 1916, 3 sheets of the Topographical Survey were published and maps of Malacca and British Malaya were completed. By 1921 the drawing of 7 1-in. sheets was completed, and in this year it is noted that 345,621 maps, plans, etc., were printed. In 1922 the map of British Malaya, 8 miles to 1-in., was published, together with a reduction to 20 miles to 1-in. The work of the Photo-litho Section continues to expand.

Instrument Repairing Section.—In 1914 two skilled Europeans were appointed. One left during the war. By 1922 all arrears of repair work had been cleared off and the work done by the Section now includes the manufacture of practically all instruments except theodolites at a lower cost than that at which they can be imported from England. A new pattern of clinometer was designed and made.

Technical School.—In 1914 and 1915 respectively 19 and 20 probationers were passed out. In 1916 all probationers were passed out for employment and progress and the school was closed. The school does not appear to have been re-opened, though the training of twenty probationers is mentioned as being carried on in 1922.

COST. ($ = 2*s.* 4*d.*)

The total cost of the Survey from 1914–22 is given in the following table. It should be noted that the revised salaries, which came into force in 1919, are included in the expenses for 1920, which accounts for the sudden increase in that year. It is not clear whether the figures for 1914 and 1915 include clerical services; apparently they do not. The figures from 1916 onwards include clerical services, and from 1917 they include temporary allowances (presumably war bonus).

Year.	Gross Cost.	Revenue.	Net Cost.
	$	$	$
1914	1,124,829	191,889	932,940
1915	968,242	201,615	766,627
1916	987,618	241,668	745,950
1917	1,004,226	261,038	743,188
1918	1,063,342	235,126	828,216
1919	1,250,869	215,864	1,035,005
1920	1,730,527	239,476	1,491,051
1921	1,744,100	257,213*	1,486,887
1922	1,575,510	313,150†	1,262,360

* Includes $80,897 from Straits Settlements.
† Includes $110,384 from Straits Settlements.

It is noted in the 1922 Report that the cost of revenue surveys has increased largely, owing to the scattered nature of the applications and to the fact that the work involved had become quite disproportionate to the fees charged. A new scale of fees has been brought into force, the effect of which will be felt in 1923.

Some details of cost of various kinds of work have already been given under the headings of Trigonometrical, Topographical and Revenue Surveys.

General Remarks.

This Survey did not suffer the complete stoppage that was the fate of some during the war. Though its activities were greatly curtailed, it was able to carry on some work in all branches, particularly in Revenue Surveys.

Generally speaking, it may be said that, subject to the limitations imposed by financial conditions, the normal work of the Survey is now being carried on vigorously.

The incorporation of the Straits Settlements Survey in that of the Federated Malay States has been of great benefit to the former, and has put the work in the Settlements on a sound footing.

The training of natives is being carried on energetically. It demands much time and trouble, but the results appear to justify the work involved.

In Revenue Surveys the arrears are being overtaken. The work is being well organised, and there is every prospect that the cost will be reduced.

The work of the Central Drawing Office and of the Photolitho Section appears to be efficiently conducted. That of the latter has expanded greatly. The Instrument Repairing Section has more than justified its existence.

It is reported that there is a growing demand for Topographical work, which is satisfactory. It is hoped that, as soon as circumstances allow, the continuation of the valuable topographical work in Negri Sembilan and elsewhere, which was cut short in 1914, will be taken up. A number of sheets were left in an incomplete state, and it would be the greatest pity if this work were wasted.

TRINIDAD AND TOBAGO.

Reports are available for the years 1914–9 *and* 1921–2.

Governor:

1914–16 ... Sir George R. Le Hunte, K.C.M.G.
1916–21 ... Lt-Col. Sir John R. Chancellor, R.E., K.C.M.G., D.S.O.
1921 ... Brig.-General Sir S. H. Wilson, K.B.E., C.B., C.M.G.

Engineer in Charge of Surveys:

1914–19 ... Mr. Edward R. Smart.

Crown Surveyor:

1920 ... Mr. John W. Macgillivray.

1. *Staff and Expenditure.*—The following table gives the facts for the period under review :—

Year	Staff.							Expenditure.		Other Charges.	
	Engineer-in-Charge.	Crown Surveyor.	Assistant Surveyors.	Draughtsmen.	Clerks.	Pupil Surveyors.	Total.	Personal Emoluments. £	Travelling Expenses. £	Survey Expenses. £	Total. £
1914–5 ...	1	—	2	3	1	—	7	1,840	210	1,800	3,850
5–6 ...	1	—	2	3	1	—	7	1,840	230	1,380	3,450
6–7 ...	1	—	2	3	1	2	9	1,840	250	1,480	3,570
7–8 ...	1	—	2	4	1	2	10	2,120	460	2,060	4,640
8–9 ...	1	—	4	4	1	2	12	2,590	590	3,130	6,310
9–20 ..	—	1	4	4	1	2	12	2,530	570	2,380	5,480
1920–1 ...	—	1	4	4	1	2	12	2,430	430	2,700	5,560
1–2 ...	—	1	4	6	1	3	15	2,430	540	2,660	5,630
2–3 ...	—	1	4	6	1	3	15	2,430	540	1,730	4,700

2. *Trigonometrical Survey.*—This survey is complete save for trigonometrical measures of altitude.

In 1919 sixteen new minor stations were established in the South Central District; this necessitated the occupation of twenty-seven stations in all, from which the observations were usually made to heliographs. The average triangular closure was 3·85 seconds, representing good secondary work.

In 1921 four tertiary trigs. were added and permanently marked with concrete pillars.

3. *Levelling.*—No mention is made of levelling except on the St. Augustine Estate, where 300 acres were contoured in 1921 to facilitate the selection of residential sites on the grounds of the College of Agriculture.

4. *Topography.*—Topography* has been considered as barely within the province of the Survey Department. A slight amount of work was carried out during the progress of the traversing, and the information obtained therefrom was incorporated on the cadastral sheets; but, except for the road traverses, the coast line and a few river courses, the work has been almost negligible.

5. *Traversing.*—Traversing appears to be usually carried on with the magnetic needle. The instrument employed is a trough compass on a theodolite and some considerable care is taken to apply the necessary diurnal, annual, secular and instrumental corrections. It seems to be agreed that local magnetic attraction in Trinidad is slight and corrected observations made with care by means of the instrument used may be taken as giving in the field a mean square error of about ± 5 minutes of bearing, the elements of residual error, after correction, being at least six in number. Where the corrections are not applied the error may be anything over ± 10 minutes of arc.

The legs of the traverses are very short, the roads being unusually devious even for a greatly broken country. Since the closing error on trigs. is of the order of 1/1,000, it appears that residual errors of the compass must be chiefly of the accidental class; the multiplicity of legs then favours their elimination.

The employment of the compass in Trinidad under special conditions gives no warrant for its employment elsewhere, not even in Tobago,—a volcanic island like many others in the West Indies.

6. *Cadastral Work.*—Some idea of the purely cadastral work carried out may be gleaned from the following tables; but as there is a lack of continuity in the reports, some of which are missing, the tables are far from being complete.

Number of Survey Orders Executed.

Year.	By Staff.					By Contract Surveyors.					Total by Staff & Contract.
	Acres ¼ to 5	Acres 5 to 20	Acres over 20	Special	Total.	Acres ¼ to 5	Acres 5 to 20	Acres over 20	Special	Total	
1914	?	?	?	?	?	?	?	?	?	?	388
5	?	?	?	?	?	?	?	?	?	?	279
6	(225)	(80)	(8)	(33)	(346)	—	—	—	—	—	346
7	171	139	14	23	347	187	121	14	16	338	685
8	87	71	7	31	196	205	157	15	7	384	580
9	(251)	(141)	(2)	(21)	(415)	—	—	—	—	—	415
1920	137	103	—	25	265	231	162	1	10	404	669
1	117	81	—	56	254	75	69	3	23	170	424
2	?	?	?	46	?	?	?	?	31	?	279

*See p. 46.

In 1917, Rice Lots, each of about half a rood, to the number of 721, were surveyed in Naparina and Manzanilla.

Year.	Traverses. General.	Oil & Forest.	Control.	Total	Lands Surveyed. Forest Reserves.	Oil Concessions.	General.	Total.	Plans. Grant, Lease, and Survey	R.P.O.
	Miles	*Miles*	*Miles*	*Miles*	*Acres*	*Acres*	*Acres*	*Acres*		
1914 ...	?	?	60	?	—	4,000	2,700	6,700	?	?
5 ...	?	?	70	?	—	—	1,300	1,300	?	?
6 ...	?	?	94	?	—	—	?	?	?	?
7 ...	?	?	70	?	—	—	?	?	?	?
8 ...	?	?	230	?	—	—	?	?	?	?
9 ...	?	?	169	?	580	1,000	?	?	?	?
1920 ...	385	—	43	428	—	17,390	?	?	1,950	800
1 ...	209	115	11	335	7,010	16,540	320	23,870	1,690	792
2 ...	139	65	88	292	—	13,180	?	?	1,016	662

It will be seen that 1921 is the only year for which the returns are complete.

The plans marked R.P.O. are those which have been checked and certified as being in conformity with the regulations of the Real Property Ordinance.

In the acreage given for concessionary and other surveys executed for the Crown Lands Department, the proportions to be assigned to the Staff and to Contract are not distinguished; apparently the surveys of oil concessions are generally carried out under contract.

In the returns it is not always possible to distinguish between Survey Orders Issued and Survey Orders Executed or Completed.

The reports laid before the Legislative Council cover the civil year, while those prepared for the Colonial Survey Committee extend to March 31st. It would seem that an assimilation of these two abstracts would be conducive to a lessening of labour; otherwise, as here, there is a risk that the work of one year may be included again in the report of the next, particularly if any returns are missing.

7. *Maps.*—During the period a considerable number of maps of various kinds have been improved, redrawn, drawn and printed. The maps of Trinidad include 124 Ward and 150 Wardens' maps, both series on the scale of 12 chains/1-in. =1/9,504. There are also " trigonometrical sheets " on the same scale, 120 in number. These maps have in many cases been reduced by eidograph to the scale of 1/50,000. A map of Tobago on the scale of 1/50,000 has also been undertaken. There are general maps of Trinidad on the scales of 1/150,000 and 1/300,000, used for overprinting agricultural information, motor and carriage roads, areas of oil concessions and the like. There is also a general map of Tobago on the scale 1/150,000. Sectional sheets and County Maps on the 1/50,000 are mentioned as well as Sectional maps on the 1/9,504 scale.

Some of these maps are printed and some reproduced by the ferro-gallic process. A synoptic table showing the present position as regards maps would be a useful addition to a subsequent report.

8. *Time.*—The Department makes solar observations weekly to correct a standard clock whereby Island Time is regulated.

9. *General Note.*—The Survey of Trinidad is in a state in general aspects considerably in advance of that of any other West Indian Colony. If some features are objectionable there is nothing to prevent their removal.

TRINIDAD AND TOBAGO.

Topographical Survey.

Staff.—This survey was instituted in 1920 and began work about 1st September of that year. The Staff consists of Captain G. H. Latham, Royal Engineers, and five R.E. topographers.

Area Involved.—The work was to be confined to the northern half of Trinidad but it was hoped that it might be possible to incorporate surveys made by the Petroleum Development Co. Subsequently the work was extended to include Tobago, which lacked a trigonometrical framework.

Bases.—The pre-existing triangulation of Trinidad forms the framework of the topography. In Tobago there appears to have been a difficulty in finding a site for a base of half-a-mile in length; such a base was chosen and measured in 1923.

Triangulation of Trinidad.—The work in Trinidad necessitated the reclearing of the old trigs. and the adoption of a number of new stations. New stations were fixed by intersection or by trigonometrical interpolation. The beacons used are quadripods of the double-cone type. The instrument employed is a 5-in. Micro. and, at principal stations, observations, F.R. and F.L., were made on two arcs when the lines did not exceed 5 miles in length; on distances of 5 to 20 miles four arcs were measured; in all cases the permissible discrepancy between a F.R. and F.L. observation was fixed at 15 seconds. For intersected and resected points two arcs were considered sufficient. Natural objects were also observed to control the topography.

Triangulation of Tobago.—The framework here is intended for both cadastral and topographical purposes. By June, 1923, the whole of the major and half the minor trigs. had been reconnoitred and beaconed—fifty stations in all. It is proposed to

connect with the main island by observing to one point on Tobago from two or more stations on Trinidad. By this means the Latitude and Longitude (geodetic) of the small island can be brought into terms of Trinidad; the azimuth also, if the point on Tobago is itself a station. As Tobago is situated ' end on ' to the main island, a connection between bases is said to be impossible.

Level Datum of Trinidad.—Some years ago a tide gauge was established at Port of Spain and its zero connected by spirit levelling with a B.M. on the railway line. The height of this Datum above M.S.L. was taken from the mean of nine months' observations on the tide gauge.

Altitudes of Trinidad.—From the Datum at Port of Spain, lines of levelling were run to two trigonometrical stations. Thence the altitudes hitherto omitted were carried forward trigonometrically by the Topographical Survey. The angular measures at primary stations were reciprocal, not less than three in number, and the maximum discrepancy from the mean measure of height-difference was $1\frac{1}{2}$ feet.

Preparation of Plane Table Sheets.—Rectangular co-ordinates of all the trigonometrical stations were calculated and laid down in the plane table sheets. The scale of the latter is 1/50,000 and the dimensions are about 12 in. by 12 in.

Any detail appearing on the 1/9,504 sheets of the Colony was reduced to the 1/50,000 scale and plotted on the field sheets.

Progress of Topography.—Some figures are scattered through the reports, which give some indication of progress. The reports cover three periods, I, II, III as follows :—

I—September 1, 1920–June 30, 1922. II—July 1–December 31, 1922. III—January 1–June 30, 1923.

(*a*) *Clearing and Observing.*—Period I—About 140 old and 30 new stations cleared and about 100 occupied for theodolite observations. 150 natural beacons observed to control topography. Period II—25 stations cleared and about 30 new stations observed; in addition about 20 stations revisited. Period III—Clearing in Trinidad nearly finished, but there remains still a good deal of observing to be done; the work has mainly involved the revisiting of old stations.

In the third period 50 stations were cleared and beaconed in Tobago.

(*b*) *Area covered by Triangulation.*—In the first period the area covered was 1,000 square miles.

(*c*) *Area covered by Plane Tabling.*—I—600 square miles. II—120 square miles. III—120 square miles.

Progress of Plane Tabling.—The plane tabling shows progress of a little over ¼ square mile per man per diem. On the 1/50,000 scale this amounts to about two-fifths of a square inch on the plane table sheet.

Though certain seasons are marked in Trinidad as wet, it is noted that rainfall is persistent throughout the year and that not more than four days a week are suitable for plane tabling.

Owing to the enclosed nature of the country, the method of sound and compass traverse had to be very generally employed; the method is said to have been satisfactory when there was a good control at either end. The northern hills, running up to 3,000 feet in height, are greatly furrowed by deep valleys and there is much irregularity of feature.

UGANDA.

Reports are available for the years 1914 *to* 1922.

Governor:

1914–16	...	Sir F. J. Jackson, K.C.M.G., C.B.
1917	...	H. R. Wallis, Esq., C.M.G., C.B.E. (Acting).
1918–22	...	Sir R. T. Coryndon, K.C.M.G.
1922	...	Sir G. F. Archer, K.C.M.G.

Director of Surveys and Land Officer:

1914–20	...	Mr. R. C. Allen, C.M.G.
1920–22	...	Mr. E. Richardson.

Deputy Director of Surveys:

1914–17	...	Mr. L. R. Fraser.
1917–20	...	Mr. E. Richardson.
1921–21	...	Mr. Dyson Blair.

Conveyancer:

1914–15	...	Mr. F. Guthrie-Smith.
1915–18	...	Mr. C. F. Belcher.
1919–22	...	Mr. W. L. Shepley-Taylor.

TABLE I.

Organization of the Survey Department.

	Year ending 31st March.							Nine months ending 31st Dec.	Year ending. 31st December.	
	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1920.	1921.	1922.
Director of Surveys, Land Officer and Commissioner of Mines	1	1	1	1	1	1	1	1	1	1
Deputy Director of Surveys	1	1	1	1	1	1	1	1	1	1
Assistant Director of Surveys	—	—	—	—	—	—	1	1	1	1
Conveyancer and Registrar of Titles ...	1	1	1	1	1	1	1	1	1	1
Assistant Land Officer	—	—	—	—	—	—	—	—	1	1
European Surveyors	13	19	19	19	20	20	20	19	18	17
Office Superintendent and Storekeeper ...	—	1	—	1	1	1	1	1	1	1
European Clerks	3	3	5	4	4	6	5	5	5	4
European Draughtsmen	1	1	1	1	1	1	1	2	2	2
Computer	—	—	—	—	—	—	—	1	1	1
Indian Surveyors	1	1	1	1	—	—	—	—	—	—
Indian Draughtsmen	2	2	2	2	2	2	2	2	2	2
Indian Clerks	2	2	1	2	2	2	3	3	2	2
Total	25	32	32	33	33	35	36	37	36	34

Table II.

Comparative Annual Statement of Expenditure and Revenue and Cost of Survey.

	Expenditure.		Revenue.		Cost of Survey per square mile.	
	Estimated.	Actual.	Estimated.	Actual.	Native Estates.	Crown Lands.
	£	£	£	£	£ s. d.	£ s. d.
Year ending 31st March, 1914...	10,130	9,524	6,190	10,460	7 16 0	10 0 0
,, ,, 1915...	13,370	11,620	10,160	8,521	4 15 9	10 15 0
,, ,, 1916...	13,945	11,870	11,530	10,477	5 1 6	39 7 0
,, ,, 1917...	13,579	10,403	13,450	10,832	8 6 6	38 8 6
,, ,, 1918...	14,179	8,900	10,626	10,402	—	—
,, ,, 1919...	13,604	8,840	10,556	10,958	—	—
,, ,, 1920...	15,247	9,296	10,986	14,261	—	—
Nine months ending 31st December, 1920	17,356	14,207	11,630	20,674	—	—
Year ending 31st December, 1921	31,289	26,414	18,500	16,742	—	—
,, ,, 1922	29,278	26,830	20,970	19,379	11 14 0	—

Table III.

1. *Comparative Annual Statement of Survey.*

	Native Estates.		Crown Lands.	
	Triangulation.	Topography.		
	Sq. miles.	*Sq. miles.*	Plots.	*Acres.*
Year ending 31st March, 1914... ...	356	663	—	23,000
" " 1915... ...	1,492	1,049	—	35,100
" " 1916... ...	583	719	—	43,154
" " 1917... ...	260	295	—	13,073
" " 1918... ...	305	20	—	1,369
" " 1919... ...	190	5	—	6,884
" " 1920... ...	—	—	—	1,620
Nine months ending 31st December, 1920	165	126	59	8,086
Year ending 31st December, 1921 ...	452	214	82	5,020
" " 1922 ...	825	791	38	683

Of the native estates in the Buganda Kingdom guaranteed under the Uganda Agreement, 1900, the total area now surveyed on the scale 1/10,000 is 7,869 miles, the triangulated area 9,000 square miles.

2. *General Triangulation and Topography.*—In 1916–17 a series of secondary triangulation covering an area of about 4,000 square miles was observed, based on Anglo-German Boundary Commission and Uganda Survey Department points in Southern Busoga, passing through Bukedi and Teso districts, and extending into the North of the Lango district. Error of principal triangles $\pm 2{\cdot}55''$. A junction of this series crossing Lake Kioga was effected in 1919 with the triangulation carried out in Northern Buganda by Captain Macfie, R.E., in 1910.

In 1921 triangulation was commenced in Toro, based on the Arc of meridian 1908 survey, to link up with the Uganda Survey Department's trangulation. One thousand six hundred square miles of primary triangulation were observed, and 540 square miles of secondary. During the following year 975 square miles of primary, and 1,100 square miles of secondary, minor and intersected points were completed; 1,032 square miles of topographical work on a scale of 1 : 50,000 were completed.

In the Eastern Province secondary triangulation was carried out in 1922 over an area of 1,550 square miles, eventually to stretch from the Nile across Northern Busoga, through Bukedi to Mount Elgon.

3. *Maps.*—The following sheets of a provisional 1 : 250,000 series were sent in 1922 to England for printing :—

North A 36 Q Mount Elgon.
,, ,, 36 R Sekerr.
,, ,, 36 W Mumia's.
,, ,, 36 O Masindi Port.
North A 36 H Mahagi.
South A 36 G Lake Mohasi.
,, ,, 35 L Mt. Sabinio.

Also revised map of Buganda Kingdom.

Eight others are in course of preparation.

In 1921 eight maps in various scales were printed in Cairo; this arrangement has now been discontinued, and printing in the future will be done in England.

Towards the end of 1922, 28 sheets of the 1/50,000 series were sent to England for reproduction; plans of Jinja and Kampala were sent at the same time.

A map index was compiled and placed on sale in 1922. It comprises some 12,000 names, with a preface giving the names of officers who have made the maps, with other information as to Base Lines, Topographical reports, etc.

The area of the Uganda Protectorate is covered by maps published by the War Office on a scale of 1/1,000,000 (G.S.G.S. 2465) and 1/2,000,000 (G.S.G.S. 2871).

4. *Summary of Township Surveys:*—

1914–15. New township at Mjanji Port and replanning of a portion of Jinja. Plots set out in Kampala, Jinja and Masindi.

1915–16. Preliminary surveys of Lira, Ngora, Gogonyo, Agu and Kumi. Establishment of the proposed bazaar on Kololo Hill, Kampala.

1916–17. Lira, Gogonyo, Ngora, Agu, Kumi and Mjanji finally demarcated. Bazaars at Jinja and Kololo Hill, Kampala and a number of plots at Lale.

1917–18. New bazaar at Jinja finally demarcated.

1918–19. A considerable amount of Survey work carried out in and near Kampala and at Jinja.

1919–20. As in previous year.

1920. Triangulation and contouring in Kampala and Fort Portal.

1921. Final town-planning scheme demarcated at Kampala. Miscellaneous work at Kampala, Jinja, Toro and Entebbe; bazaars at Iganga, Kaliro and Fort Portal.

1922. Plots at Kampala, Iganga, Jinja and Fort Portal.

5. *General Remarks.*—The war had a gradually increasing disorganizing effect on the Survey Department until, at the end of the period 1916–17, survey work was practically at a standstill. Many members were assigned to military duties and the work of the Drawing Office was largely of a military nature. This state of affairs continued during the next few years, and it was not

until 1920 that matters began to improve. During the year ending March 31st, 1919, out of twenty Surveyors there were nine absent on military service and eight vacancies unfilled. Though by the end of 1920 there were only six positions unfilled, several of the Surveyors were of little practical use, owing to lack of training; in 1921 there were scarcely any vacancies.

1921 was remarkable for the great and increasing difficulty in obtaining labour for survey work on native estates and for the large increase in the cost of this labour. The work performed by volunteer porters was very unsatisfactory. The demand for Crown Lands was small and the depression in the planting industry remained.

In 1922 a new chart for the Eastern Arms of Lake Kioga was prepared by Lieutenant-Commander Buckler, R.N.R., and Lieutenant Watts, R.N.R., both of the Uganda Railway Marine. Makerere Technical College was opened, three Survey Scholarships being allotted to natives of the Protectorate.

LAND OFFICE.

Leases and Grants of Land
(other than grants to Natives under the Uganda Agreement of 1900).

Table IV.

Period.	Leases.	Grants.	Surrenders, Forfeitures or Falling-in of Leases due to Grant of Freehold.	Net Gain.
1913–14 ...	154	59	50	163
1914–15 ...	47	37	57	27
1915–16 ...	40	40	36	44
1916–17 ...	111	27	20	118
1917–18 ...	63	16	21	63
1918–19 ...	76	10	12	74
1919–20 ...	137	18	16	139
1920 (Nine months) ...	66	18	19	65
1921	69	12	24	57
1922	42	5	31	16

SPECIAL REPORTS ON THE SURVEYS OF SOME WEST INDIAN COLONIES.

A general discussion in 1922 of the surveys, topographical and cadastral, of Trinidad brought up in its train the general question of the Surveys of the West Indian Colonies generally. It was discovered that the information concerning these surveys and the land enactments by which title is assured, was extremely scanty, and that the reports received on the subject from individual Colonies were insufficient in material and given in unsuitable form. The Colonial Survey Committee were well aware of the lack of reliable mapping in these Colonies, but felt unable to help towards the solution of local difficulty without a knowledge of the facts. At their meeting in January, 1922, the Committee decided, therefore, to issue a questionnaire with the object of compiling a statement which might be at once a help to themselves and a guide to the Colonies in question.

Answers to the questionnaire were duly received, and from them have been drawn up a series of short reports or summaries which provide an authoritative statement of present conditions. These summaries are now printed on the following pages.

Questionnaire on the State of the Surveys of the West Indian Colonies.

1. Statement of the Fundamental latitudes and longitudes of the Colony and the data on which they are based.

2. Particulars of the Trigonometrical Framework (if any) of whole or part.

3. The state of preservation of the stations of this framework and the availability of the records of measures and results.

4. If there be no Trigonometrical Survey, is there a framework, complete or incomplete, of Standard Traverses?

5. Particulars of Standard Traverses, such as density, permissible error, preservation of stations, records, etc.

6. If Standard Traverses do not exist, is there a framework of minor traverses, tied to a trigonometrical control?

7. Particulars of Topographical Survey, if any. Date of survey, scale of maps, method of indicating hill features, etc. Where maps are available, copies should be forwarded.

8. Particulars of Cadastral Survey. Dates, progress, extent of area under survey, and present situation generally.

9. What are the methods which were and are employed to control this survey? How was the survey itself conducted—by theodolite or compass traverses, or in what other way?

10. Is the Cadastral Survey in need of revision? Have difficulties arisen as to the boundaries of properties?

11. A statement of the methods by which boundaries and areas are recorded and the extent to which survey is an index to title.

12. A copy is required of the land enactments by which properties are defined and title assured.

13. Particulars of any Engineering Surveys and the use to which they have been put to complete the topography or cadastre.

SURVEYS OF WEST INDIAN COLONIES.

I.—Bahamas.

1. The geographical positions are taken from the Admiralty Charts; but there being no triangulation in the group no use is made of these for any local purpose of survey.

2—6. There are no triangulations or standard traverses in the group.

7. The only general topographical information is that derivable from the Admiralty Charts and small-scale maps reproduced therefrom. It may be stated, however, that, in the course of making surveys for Crown Land Grants by compass and chain, topographical features are noted on the traverses, such as coast lines, creeks, prominent hills, roads, etc. In many parts of the group the terrain is flat and featureless, without hills, streams, ponds or made roads; there are considerable areas of bush or pine forest.

The Charts show very few features in the interior, except lakes, lagoons and salt-ponds and some few indications of the general nature of the country. The principal of the numerous Charts are:—389, Bahama and Abaco, 1/326,000; 1435 and 1489, New Providence, 1/14,530 and 1/37,800; 1452, City of Nassau, 1/4,150; 1474, Gt. Exuma, 1/29,500; 1496 and 2077, Andros Land, 1/293,500; 20757, Eleuthera I., 1/293,500; 2075, Long I., 1/300,000; 393, Crooked Is., on various scales.

8. There is no regular cadastral survey, but irregular land surveys are made in laying out lands for sale and in preparing Crown Grants.

9. These surveys are made by compass and chain. The coast lines as shown on the Admiralty Charts are taken as the framework on which these compass traverses are based. The boundaries of private lands are marked on the ground by lines cut through the bush, the corners being fixed by piles of stones or marks cut on trees—methods assuredly rough.

The survey so made is plotted upon a general compiled map; new grants are plotted by adding to the already plotted plans of former grants.

10. Difficulties have at times arisen concerning boundaries, but such are not of frequent occurrence; any which arise are settled by reference to the plans attached to the original Grants from the Crown.

11. A Crown Land Grant describes in its text the situation and boundaries of the property; a plan is attached to each Grant showing its shape and area and such topographical features as exist on the boundaries.

Every Grant is filed in the Office of the Registrar of Records in the City of Nassau and a complete list is in existence of all Grants made from the Crown to private persons. Each Grant can be located on the general compiled map and on the ground from these records. In spite of the primitive methods used and the possibility of errors in the plans, they seem to fill the requirements of the case and are accepted as full evidence of title.

12. There are about 80 enactments covering questions of acquisition, partition, transfer, trust, escheatment, intestacy, building extension and so forth. The Surveyor who visits the Out Islands is a member of the Departmental Staff; if all survey is under the direct control of the Surveyor-General, departmental regulations take the place of legal enactments. There is not sufficient technical information in the reports to give any indication of the accuracy required.

13. No engineering surveys have been made in the group.

II.—Barbados.

In this Colony the conditions appear to be unique.

There are no Crown Lands in the Colony, and private properties have been fixed for a period so long that no questions of survey appear to arise unless on occasions of the rarest occurrence.

There being no opportunity for acquisition or development, the only matters involving land would be questions of transfer and partition and such like, and these appear to be arranged without difficulty.

There is no information as to land tenure, land records or plans for title, the Governor stating that there are no particulars available from which to supply the desired information. It would appear then that, from the point of view of survey, the island has for the present at least reached a stage of almost complete stabilization.

No military or naval question, nor even such a matter as tourist development, is at present under discussion, so that there is no demand for topographical maps beyond those which already exist. In respect of such maps in the past the Colony has been singularly fortunate.

A complete survey of the island was made by William Mayo as far back as 1721. A topographical map, based on this survey, was prepared by Sir Robert Schomburgk in 1846, the scale being 2 in./1 mile. An improved edition of a 1-in. map, engraved by

Thomas Jefferys, was issued by Richard Laurie in 1846. In 1869 there was produced the admirable chart No. 2485, being the results of the survey by Commander J. Parsons at 1½ in./1 mile. Unlike many marine charts, this sheet gives a complete representation of internal topographical features, hills being in hachures. Mayo's work is amplified and the number of spot heights increased, so that approximate contours are drawn on the geological edition of Parsons' map, prepared by J. B. Harrison and A. J. Jukes-Brown at some date preceding 1891.

There is also a chart, No. 502, of Bridgetown and small scale reproductions of maps by the Intelligence Department of the War Office.

III.—British Guiana.

Very full information of the present state of survey in British Guiana is contained in the report by the Commissioner of Lands and Mines under date 1922, 15th September. The following abstract is merely a summary of the facts contained therein, with occasional additions.

1. *Fundamental Latitudes and Longitudes.*—The fundamental position in the Colony is that of Georgetown Lighthouse; the latitude, 6° 49′ 20″ N., and longitude, 58° 09′ 47″ W., are taken from the Admiralty Chart.

There are about 80 secondary astronomical stations the longitude of which has been fixed by transport of time, apparently from Georgetown, one to three chronometers having been carried. There are no W/T longitudes. As the Colony is within easy range of American stations, the signals from which are being received daily at Greenwich, it is to be hoped that the precision possible from direct connection with the fundamental zero of longitude will soon enable a large number of astronomical stations to be fixed with comparatively great accuracy (apart from deviation of the vertical) and at a trifling cost.

The latitudes and the local times have been determined by 6-in. and 8-in. transits; in some cases six pairs of north and south stars are mentioned as having been observed for latitude.

In addition to the astronomical positions, the geodetic latitudes and longitudes of a number of points have been computed from adjoining astronomical stations.

2. *Trigonometrical Framework.*—No trigonometrical framework of any portion of the Colony exists.

Starting from a small base measured at the Penal Settlement, Mazaruni, there is a minor triangulation of portions of the Cuyuni, Mazaruni and Essequibo rivers, all confined within a radius of 12 miles from the Tower of the Prison in the Settlement.

Ninety per cent. of the country is heavily timbered; a trigonometrical survey would therefore involve heavy clearings. Except Roraima and its companion Kukenaam (8,635 and 8,622 ft.), a group of high mountains in the same frontier region, and other summits rising perhaps as high as 5,000 feet on the southern boundary, the average height of the higher hills in general appears to be well under 2,500 feet; and these hills appear to be well distributed over the Colony with the exception of the coastal region. There is, however, no information available as to the persistence of cloud or haze on hills of the latter class.

3. *Marking of Trigonometrical Stations and Traverse Stations and Bench Marks.*—The trigonometrical stations are marked by posts, locally known as " paals." In no cases have intermediate traverse stations been permanently marked, and even terminal stations have been seldom marked by paal or beacon. The paal now used on traverses is either : (1) a hardwood pole 4 ft. x 4 in. x 2 in., painted white with engraved figures, or (2), at every fifth mile, an iron paal with crown and black figures painted over white.

Surface levels along the route are determined trigometrically. Permanent bench marks are established at intervals. These consist of earthenware pipes, filled with concrete, sunk into the ground and connected to a concrete " raft " resting on short piles; the pipe is covered with a layer of cement flush with the top of the pipe, on which is engraved the number, etc.

4, 5 & 6. *Standard Traverses.*—There is an incomplete framework of 10 traverses. Four of these were unclosed traverses carried out with a 4-in. transit theodolite and 100-feet steel tapes standardized for a tension of 20 lb. and a temperature of 85° F. In some cases the distances were measured twice and the bearings were frequently checked by observed azimuths.

Two other traverses follow the two banks of the Demerara River for 52 miles; they were divided into three sections which were closed by connecting trigonometrically the east and west banks of the river. The angular error did not exceed 12 seconds and the linear error 1 in 2,000.

The longest traverse, known as the Cattle Trail, was run 187 miles to connect Takana, on the west bank of the Berbice River, to Annai Landing, in the Savannahs bordering the Rupunini. This traverse was executed with a 6-in. vernier theodolite reading to 20 seconds, a 4-in. micrometer transit reading to 10 seconds and Chesterman 100-ft. bands standardized as above; the line was measured twice and the bearings were frequently checked by the means of morning and evening solar azimuths, but no corrections were applied for the sag or the temperature of the steel bands. The tapes were standardized in catenary by the makers, but no correction was applied for

change of sag due to superelevation of one terminal of a chain-length; it seems regrettable that an invar tape, standardized at the National Physical Laboratory and two marking tripods are not retained at the Survey Headquarters for comparing the steel tapes in catenary. It should be noted, further, that rustless steel tapes, having much the same low dilatation as invar, are now obtainable in England.

Two boundary traverses were run to determine the Venezuelan frontier, one tachymetric, the other by subtense bar. A traverse was also measured from the junction of the Essequibo and Abazaruni to Rockstone for the purposes of railway location.

There are no minor traverses tied to trigonometrical control.

7. *Topographical Survey.*—There has been no topographical survey in the Colony, as distinct from rough, small scale mapping.

8 & 9. *Cadastral Survey.*—Although no systematic cadastral survey has been undertaken, survey of alienated lands has been carried out both before and after 1804, *i.e.*, under Dutch and British sway.

Of the 57 million acres in the Colony, a little over 3 million had been alienated prior to the end of 1921, under different forms of title requiring survey. Of this area, about 636,000 acres were granted during the Dutch occupation, and of the remainder only about 600,000 acres have been surveyed; 1,800,000 acres in the hinterland, recently leased for grazing, still await survey control.

Up to 1890 all surveys, including those made during the Dutch regime, were carried out by chain and compass traverse on the magnetic meridian, without reference to the variation of the needle. All surveys for title made since 1890, ordinarily limited to 10 acres, have been carried out by theodolite and steel band, and it is required that one line be laid down by solar observation for true bearing.

To define property boundaries, the lines must be cleared and kept cleared to 6 feet of width. To mark holdings within rectangular confines, the common shape of small and old grants, 6 paals are used, one at each corner and one directional paal a convenient distance down each side line. One at least of the paals must be of iron or stone.

In the case of larger areas and irregular figures closed traverses are made. The allowable limit of angular error is 15 seconds with a 4-in. instrument—a sufficiently strict closure; in distance the error of closure is fixed at 1 in 1,000 in open land, 1 in 500 in forest areas and 1 in 2,000 in mining surveys.

Lands taken up for mining purposes are held almost exclusively under Claim Licences, a form of title which does not involve survey though it necessitates beaconing and clearance of boundaries.

10. *Bourdaries of Properties.*—Considerable difficulties have arisen owing to :—

(*a*) Annual change of declination;
(*b*) The Dutch measures;
(*c*) The disappearance of old boundary paals;
(*d*) Incorrect chaining.

(*a*) The variation of the needle was first established by the Georgetown Observatory in 1847; but the declination has been deduced for the year 1765.

(*b*) Up to 1914 the standard measure was the Rhynland rood of 12 Dutch feet=12·356 English feet. 300 square Rhynland roods=1 Rhynland acre=1·051446 English acres. In the County of Berbice, however, land was measured by the " Ketting " of 66 Rhynland feet, and 302½ square roods formed the Dutch acre.

Since 1914 the English foot has been made the legal measure.

(*c*) The littoral and riparian lettings of the Dutch period were under H.W.L. and were worked on the polder system. The trenches thus made between the holdings are permanent evidence of boundary; but beyond tidal influence the disappearance of boundary paals has led to some difficulty, chiefly by reason of ignorance of the magnetic declination at the epoch of survey.

(*d*) Mistakes in chaining and failure to properly stardardize the chains used have been productive of much error.

11. *Records and Title.*—At the present time an average of 400 isolated cadastral surveys of tracts of from 5 to 10 acres in extent are carried out yearly by the surveyors attached to the Department of Lands and Mines, by whom all surveys of Crown Land for title are made with the exception of such contract surveys as have been mentioned on page 5.

Under the Land Surveyor's Ordinance a copy of every plan made by a private surveyor must be recorded in the Department of Lands and Mines; before record in the Deeds Registry each such plan is checked in the drawing office as far as possible.

Surveys after being checked as to bearings, distances, etc., are embodied on what is called the " Stock Map " of the locality. A consecutive and joinable series of cadastral maps in sheet form for record purposes is being constructed by the continuous plotting of the diagrams attached to titles, each sheet embracing 10′ of lat. by 10′ of long.

Two remarks may be made regarding these sheets.

(1) Without some form of control, such as a trigonometrical or main traverse, it is of course realised, in Guiana as elsewhere, that there is a narrow limit to what may be described as the " Addition Method " of map making.

(2) Cadastral sheets should be based on a grid, not on the graticule, a rule applied almost universally. The corners of plots must eventually be placed on a rectangular co-ordinate system which practically postulates rectangular, not curvilinear, sheets lines. These rectangular co-ordinates have to be drawn up on some form of projection. The configuration of British Guiana is meridional and the Colony can be placed on a single Cassini or Transverse Mercator projection, preferably the latter, with 59° W. as the central meridian.

But in the absence of a trigonometrical survey or a sufficient number of main traverses and more particularly of a reliable fundamental latitude and longitude (or geodetic mean of such), it appears as yet somewhat too soon to adopt a suitable projectional system, with its appropriate rectangular co-ordinates. So soon as fundamental geographical positions are determined, the process of conversion should be undertaken and present efforts should keep in view this eventual conversion to a proper projectional system. Under such a scheme the survey for title will give the corners of the holdings simply in terms of this universal Colony system of rectangular co-ordinates, which for convenience, simplicity of reference and accuracy of working can have no rival.

12. *Enactments.*—The Colony has by suitable enactments and instructions, dated up to 1919, endeavoured to transform the old and inaccurate methods to a system of progressive order; it is to be congratulated on its present attempts towards greater simplicity, accuracy and general knowledge of its territory.

IV.—British Honduras.

1. *Fundamental Positions.*—A fundamental latitude, longitude and azimuth have been determined this year by the Admiralty. In the report dated 12th February, 1923, by Captain H. P. Douglas, R. N.,* of H.M.S. " Mutine," the following facts are given :—

Jesuit Tower Flag Staff, Belize.

Latitude	17° 28′ 58″.92 N.
Longitude	88° 11′ 48″.18 W.
Azimuth of Cocoa Plum Trig. Station ...	172° 33′ 52″.

Note.—The trigonometrical station on Cocoa Plum Cay requires permanent beaconing.

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*In 1924, September, Hydrographer of the Admiralty.

The observations for latitude and time were made by a prism astrolabe, and Greenwich time was obtained by Wireless Night Signals from Washington Observatory.

The positions of six other points were determined and fixed by rectangular co-ordinates based on the meridian of the tower of the Jesuit College. Calculation will show the projection on which these co-ordinates were computed.

The positions of two more points were fixed by the British Honduras-Guatemala Boundary Commission of 1859.

2–7. *Trigonometrical, Traverse and Topographical Surveys.*—There are no trigonometrical surveys (save that of the Admiralty), no standard traverses or minor traverses tied to a trigonometrical control, and no topography in the proper sense of the term.

Apparently no system of projection has been adopted, and the boundaries of properties are not defined by rectangular co-ordinates. As the configuration is meridional, the extreme width of the Colony not exceeding $1\frac{1}{2}°$, a single meridional projection, based on the meridian of 88° 30′ W., would cover the whole Colony with a scale error not exceeding 1/10,000.

8. *Cadastral Survey.*—This is the only kind of survey conducted in the Colony. In the early part of the nineteenth century lands were alienated in large blocks; but whereas in other Colonies the depths of the blocks from the sea margin were stated in terms of a unit reasonably small—the fathom in Fiji for example—in Honduras the unit was the mile. Eight miles was then fixed as the maximum depth, and the surveyor's work was limited to a compass traverse of the littoral or riparian frontage. In most cases the magnetic bearings of the side lines were assigned; but the side lines and the back line of the block were neither measured nor even beaconed, and in a very large number of cases the side and back lines have not been opened up to the present day.

The lands of the Colony may be divided broadly into three groups: (1) The large estates mentioned above, granted by the Crown to private persons; (2) unalienated Crown lands; (3) a large number of comparatively small holdings, usually less than 100 acres, which have been sold or leased. These plots are naturally situated in the neighbourhood of the rivers, the Government having never restricted settlement to defined areas; in consequence the poorer lands in many parts remain unoccupied.

The various groups of land are shown on a sketch map prepared by the Survey Department.

9. *Cadastral Methods.*—Before 1886 the method of surveying was by compass and chain. Since that date the theodolite and chain or the tachymeter have been employed. Traverses are closed on themselves or on other points whenever possible, and bearings are determined and checked by astronomical observations. The closing error is in general within 1 in 1,000.

To fix the position of the property the method employed is to traverse along the rivers; when the cost would not be excessive traverses are also made to connect with pre-existing surveys. Surveys of lands behind the frontal estates are linked with the surveys of the latter, as commonly in countries where no effective control has been established.

The Survey Department has been employed on: (1) The surveys of towns; (2) of a few large estates; (3) and, more particularly, of the smaller estates. About 647 square miles in all have been surveyed.

10. *Difficulties and Proposals to overcome them.*—In the present state of development it is unnecessary to revise the Cadastral Survey; but it will become necessary in the event of any considerable amount of fresh enterprise. The present state of the survey has arisen through indifference as to boundaries and the omission of the Government to compel proprietors to clear and beacon them.

Difficulties have arisen as to the boundaries of properties; but these are generally settled by agreement. Even agreement, however, may be in some cases expensive, the Government itself having recently been put to great expense in payment of damages arising from an imperfect survey. In the event of the land becoming more valuable, disputes and litigation will certainly increase.

The most important need at the present time is for a trigonometrical framework, to which may be tied existing surveys of known accuracy, the corners of the estates not yet delimited, and all future surveys.

If the proposal to open the southern portion of the western frontier of the Colony is carried into effect, it will be necessary to triangulate between the two ends of the boundary in order to determine accurately their relative position. When longitudinal triangulations are made to connect this western frontier with positions on the coast whose latitudes and longitudes are known beyond question, a beginning may be made immediately to put the whole survey of the Colony on a single system with a known meridian, a fundamental origin, a well-determined basis of linear measurement, a fundamental azimuth and a definite and suitable projection.

11. *Land Enactments.*—Survey is no index to title; but persons having doubtful titles can register them, and these titles become valid if no opposition is offered within a prescribed period. Few persons take advantage of this provision, and the number of defective titles is large.

Copies of plans of all boundaries must be lodged for record in the office of the Registrar-General, who is also Keeper of Records. The enactments governing the survey and delimitation of property and the conditions requisite to secure title are contained in certain chapters of the Consolidated Laws and in Ordinance No. 22/1915.

12. *Engineering Surveys.*—The only engineering survey in the Colony is that of the Stann Creek Railway, which has been utilized in the same manner as the river traverses for determining the position of lands adjoining the railway.

13. *Maps.*—The principal general map of the Colony is on a scale of 6 miles/1 in.; it was compiled in 1911 and reproduced by the Ordnance Survey in 1912. The tracing showing the groups of land which accompanies the Surveyor-General's report is dated 4th May, 1922, and is on a scale of 1/295,729. This map shows that the freeholds exploited for mahogany almost absorb the northern portion of the Colony. The Admiralty charts are numbered 522, 959 and 1797.

V.—Jamaica.

1. *Fundamental Positions.*—The origin for latitudes and longitudes which was used for the trigonometrical survey of Kingston and its vicinity had been fixed by the U.S.C. & G.S. This point, 12 feet west of the centre of the pedestal of the statue at the southern end of King Street, was found to have the following geographical co-ordinates :—

Latitude, 17° 57′ 40·98″; Longitude, 76° 47′ 39·705″ W.

Another point, included in the Nautical Almanac, is Kempshot Observatory in the Montego district :—

Latitude, 18° 24′ 51″; Longitude, 77° 52′ 22″ W.

Based on the former are the geodetic values of the geographicals of the stations of the triangulation.

The Admiralty have also fixed a number of points around the island.

2 & 3. *Triangulation.*—The only work of this nature was that executed in 1904 by the Colonial Survey Section under Captain G. S. Knox, R.E. It is not known if the stations, situated in St. Andrew and St. Catherine, were ever permanently marked, no funds having been allotted for this essential purpose. The records are available at the War Office and from time to time copies have been transmitted to Jamaica.

4.–6. *Traverses.*—There are no standard traverses in the island nor any minor traverses tied to a trig. control.

7. *Topography.*—Based on the triangulation aforesaid, the Colonial Survey Section carried out the topography of Kingston and its environs on the scale of 1/25,344 or 2½ inches to the mile. This topographical work was extended by Captain E. J. Pomeroy

in 1909–1912, and five sheets were prepared and printed by the Ordnance Survey. This work was discontinued by the War Office owing to local indifference and the refusal of the Colony to make any contribution to the undertaking.

A compilation was carried out by Mr. C. Liddell of a map in two sheets on the scale of 2·698 miles to an inch. This map, produced in 1888 and revised in 1905, is the source of information as to the geography of Jamaica. Many interesting features, such as the swallow-holes and grottos of the interior limestone, are indicated on these two sheets, on which, however, relief is shown by hill shading only and apparently not a spot height is given; in the absence of a framework, no notion of the accuracy of the map is obtainable. Regarding it, the present Surveyor-General states that a tourist map prepared from it "would not be accurate and would be incomplete as regards many of our parochial roads."

On a revision of this map, between 1912 and 1915, £600 had been expended; but though the scale had been reduced to 1 inch, the revision was not completed. Relief on this revision is represented in a general way by hachures and the elevation of important points is given. A good topographical map is a necessity which few seem to appreciate.

8. *Cadastral Survey*.—No cadastral survey has ever been carried out on a systematic basis. Isolated surveys of property boundaries began to be made shortly after the occupation of the island in 1655.

At the present day a small part only of the island remains "unpatented." Survey to-day appears in considerable measure to be concerned with the division of the larger into smaller holdings.

The fact that the greater part of the land has been already alienated would imply that the conditions in great measure are the same as those which faced Europe at the beginning of the 19th century. With the present greater knowledge of methods, a general survey would have the advantage of tackling a well-known problem with modern methods.

9. *Cadastral Methods*.—The compass and Gunter chain remain as the established instruments. The Surveyor-General's report does not give any information as to the procedure used to check these surveys; but much can be gleaned from the report prepared by his predecessor. Apparently no attempt is made to apply the change of magnetic declination, much less the diurnal change. A closure of 1 in 300 in linear dimensions is apparently permissible.

The primitive method of survey abandoned almost everywhere is thus still in vogue in Jamaica. In Trinidad, it is true, the compass is still used; but there a compass theodolite reading by estimation to minutes is employed, magnetic attraction is said to

be almost entirely absent, the various corrections are known within limits and are applied and the closure of minor traverses is something of the order of 1 in 2,000, though the legs are in general short; moreover, there is a general trigonometrical control.

The conditions in Jamaica would not be so bad were there any effective official control on the surveys, such as they are.

10. *Difficulties as to Boundaries.*—Disputes as to boundaries among the large landed proprietors are of rare occurrence, but among the smaller settlers disagreements resulting in recourse to the Courts arise more frequently. The Government itself is seldom involved and the rare differences are settled by agreement.

11 & 12. *Records, Titles and Enactments.*—The recording of boundaries and areas is carried out in cases where application is made to the Registrar of Titles or to the Deputy Keeper of the Records. Mere survey is not an index to title, except in special cases. When a survey has remained in the Island Record Office for twelve months without a denunciation of its accuracy, it is deemed to give a correct representation of the boundaries of the property. The Law 21 of 1888 appears to deal chiefly with the legal aspect of title; the requirements of the " plot or diagram " are not there defined.

The Land Surveyor's Law (31 of 1894) appears to be the chief instrument governing the qualifications and work of the surveyor.

This law is open to criticism on several grounds:—

(*a*) A corporate member of the Surveyor's Institution of Great Britain and Ireland is most frequently a Land Agent, without any special knowledge of survey.

(*b*) An examination conducted by the Surveyor-General and a Commissioned Surveyor is not sufficiently independent.

(*c*) No ruling is made as to the right of the surveyor to enter any land other than unoccupied land, in order to survey properly an adjoining property.

(*d*) No indications are given as to the methods by which the survey is to be conducted.

(*e*) Nothing is laid down as to the manner in which the plotting of the survey is to be presented on paper.

(*f*) No powers appear to be conferred on the Surveyor-General to enable him to denounce effectively an inaccurate survey.

It would appear that an effective survey ordinance, drawn up on the lines of the more progressive Colonies, is one of the chief necessities if improvement is to take place.

13. *Engineering Surveys.*—Various engineering surveys, of railways and roads for example, have been made from time to time; but these surveys have never been utilized or even recorded in the Survey Department.

14. *Remarks.*—It is remarked that in the absence of a framework it is impracticable to locate accurately, on a map of Jamaica, a registered title.

The present antiquated method of making plans by the use of the magnetic compass is quite untrustworthy, especially in a country where wire fences are common and the amount of the local attraction is unknown.

There is no regulation which compels the commissioned surveyor to have his compass tested for variation or accuracy; much less to insist on an instrument of special type, on the application of the diurnal corrections or on the avoidance of the needle in regions affected by magnetic disturbance.

The inaccuracy of many of the "plans" of properties is notorious, so that it is superfluous to stress the urgent need for reform, which is almost universally recognised.

15. *Maps.*—The maps of the island are as follows:—

Scale.	No. of Sheets.	Nature.	Name.	Date.
1 in./2·698 miles ...	2	Compiled ...	C. Liddell ...	1888 & 1905
2½ in./1 mile ...	5	Topographical ...	Knox & Pomeroy	1905 & 1912
1 in./8 miles ...	1	In four colours	I.D.W.O. ...	1900 & 1912
1 in./1 mile (sketch maps)	1	Clarendon Dist.	Major Edge ...	1902
,, ,,	1	Hanover Dist.	(Manœuvres) ...	1903
1/250,000	1	School map in layer tints.		

VI.—Leeward Islands.

Antigua and Barbuda.

1. *Description.*—Antigua (108 sq. miles) is grouped with Barbuda (62 sq. miles) and Redonda (½ sq. mile).

In Antigua the hills are low except in the S.W., where Boggy Peak rises to over 1,300 ft. The few rivers are also in the west and as springs are rare the water supply is somewhat precarious; fortunately the rainfall is not meagre, varying from 35 to 60 inches.

Barbuda was long a cattle and horse ranch. The "highlands" on the east rise two or three hundred feet and a great lagoon on the west almost severs the northern extremity from the

main island. The only information as to the topography and configuration of Barbuda is that derivable from Admiralty Chart No. 1997.

2. *Fundamental Positions in Antigua.*—The position best fixed in Antigua is that of the north tower of the Cathedral of St. John's. Lat., 17° 6′ 14″ N.; long., 61° 50′ 28″ W. The longitude is based on a telegraphic determination by the U.S. Navy. The Admiralty give also the lat. and long. of the Flagstaff of English Harbour Dockyard, the long. having been based on carried time from Langs Observatory, Santa Cruz I., former Danish West Indies.

3–9. *Survey in General.*—There has been no trigonometrical survey, no standard or control traverses and no general cadastral or topographic survey.

10. *Boundaries of Properties.*—In many cases boundaries are very vaguely defined; in some cases there is no delimitation whatever. Of Crown Lands the following plans are in existence :—

(1) Body Ponds Land. Tracing made in 1884 of a survey made by W. M. Shervington in 1849; scale, 5 chains/1 inch.

(2) Clare Hall Land. Plan of survey in 1890 by H. M. Adams; scale, 10 chains/1 inch.

The Governor hopes to have the defects in the plans of Crown Lands remedied forthwith.

11 and 12. *Enactments and Title.*—A Registration Act was passed in 1886 which put the holding of land on a more secure basis. The Act introduced the necessity for a plan and the manner of assuring title was defined.

13. *Engineering Surveys.*—There are no records of engineering surveys except perhaps those of the Admiralty Dockyard on English Harbour.

14. *General.*—The country being generally flat, the fixing of a comparatively few trig. stations on either Antigua or Barbuda would open the possibility of cheap survey by aeroplane, provided that machines were engaged on a circus of operations in the West Indies. The photos so taken, by reason of the complete delineation of all visible surface features, would form a valuable record apart from any question of real survey.

It must not be considered however, that an aerial survey is capable of affording a plotment sufficiently accurate for cadastral purposes without an expenditure at least comparable with that of ground survey.

15. *Maps of Antigua.*—It is remarkable how the primitive map of John Luffman, of date 1787–88—4 sheets on the scale of 1½ inches/1 mile—is more or less perpetuated to the present day.

The best of the old maps is that of Shervington, 1852, at about 2½ inches/1 mile, reproduced by J. and C. Walker (4 sheets). Jeffery's map of 1860, on a scale of about 1/55,000, shows the sloppy work characteristic of that cartographer. The last revision of the compiled map is by H. M. Adams, 1891; this has been found very inaccurate. For the outlines of the island the later compilers are indebted to the Admiralty surveys of 1848 and 1863. Besides the general chart (reproduced without material change by the U.S. Navy), there are excellent charts of St. John's, Falmouth, and English Harbours.

VII.—Windward Islands.

(*a*) Grenada.

1. *Description.*—Grenada is an island of about 130 square miles, healthy, well-watered, mountainous and picturesque. Like the Caribbean chain in general it is of volcanic origin. Unlike some other West Indian Islands, it is well provided with roads and is comparatively prosperous. The island possesses some fine anchorages: St. George Harbour is the chief port but Port Egmont appears to be the finest natural inlet. The highest hill, Mt. St. Catherine, rises to 2,750 feet and on a central plateau is situated a mountain pond, the Grand Etang, 1,750 feet above S.L.; on the N.E., Lake Antoine fills a nearly perfect crater.

2. *Fundamental Positions.*—There is no good determination of longitude; the longitudes of the chart are dependent on time carried from the flagstaff on the Water Battery at Port of Spain, Trinidad.

3. *Triangulation.*—Triangulation of some of the main peaks in the island was started in 1891 by the then Director of Surveys, a base line being measured near Morne Jaloux, S.E. of St. George. Of this abortive attempt apparently neither field marks nor office records exist.

4–6. *Traverses.*—No main or minor traverses have been surveyed.

7. *Topographical Survey.*—For a geographical knowledge of Grenada, Admiralty Chart 2821 is the only authority. This survey, made by J. Parsons, Master R.N., in 1859, shows the relief in the usual form of hachuring; but the survey of the hill features in the interior is apparently complete and the lasting value of good work is again put in evidence. If the survey of Pinel

in 1783 be considered meritorious in view of its date, even its quality as " improved " by Lieutenant D. Patterson in 1796 barely admits comparison with the Admiralty work. The value of Jeffery's map is indicated by the fact that the " new edition " of 1864 is a poor reproduction of the old French work of 80 years before.

8. *Cadastral Maps.*—Gavin Smith's map of 1801, revised in 1824, represents the only English attempt made at cadastral survey; the scale is 2 inches/1 mile. It was apparently based, to some extent at least, on Pinel's earlier survey. A revision of this map, in black, was printed by the I.D.W.O. in 1900. Of this map the Assistant Superintendent of Works reports in 1922 :—

> " Gavin Smith's plan of Grenada defines some property boundaries as they may have existed in those days; but the main roads and first and second-class byways appearing on Smith's plan were reproduced 75 years afterwards without having been surveyed.
>
> " Great doubt exists as to whether this—still the standard map of the Colony—was the result of a general cadastral survey; recent investigations in certain localities prove that the plan was not prepared from first-class traverses. It is a mass of errors; estates overlap each other; in short, it cannot by any stretch of imagination be regarded as a faithful representation on paper of what obtains on the ground."

The Governor also states that instances have arisen in which it has been discovered that land owners are in occupation of Crown land, and that there are doubtless many such cases.

9. *Cadastral Methods.*—No information is available as to the methods employed by Pinel and Gavin Smith; but it is fair to assume that they did not measure main traverses.

> " Some of the properties have, since then, been surveyed by the antiquated unreliable method of the magnetic compass; in many cases with a circumferentor. These independent, untrustworthy surveys are not tied to any fixed stations or standard traverses; and the areas of plots of lands have in many instances been calculated inaccurately."

There is no limit of permissible error provided for and controlled by Government.

10. *Delimitation of Properties.*—Changes in ownership have occurred on estates, their boundaries have been altered and innumerable sub-divisions have taken place. Difficulties as to property boundaries are frequently arising, and even the Crown cannot assert its rights in some cases.

The present situation is chaotic. A proper cadastral survey with trigonometrical control is a pressing necessity. Thereafter, moreover, as an assurance to all property owners, private and public, Government control will be demanded.

11. *Plans of Properties.*—Modern methods for surveying and recording the boundaries of properties are not employed. An Ordinance of 1892 set up rules for the guidance of surveyors, but they are not observed.

As soon as a primary survey has been undertaken it is to be hoped that all the cadastral maps of the Colony will be placed on a suitable projection. This implies the choice of a central meridian, say that of 61° 40′ W., and the adoption of a grid system, in which grid North will supply throughout the island the referential and working zero of bearing. The corners of properties will then be defined by their rectangular co-ordinates in the grid.

A single system of this nature can be applied, without appreciable projectional error, to the whole island, and the maps, like those of the 1/20,000, 1-in., ½-in. and ¼-in. of Great Britain, to name the Homeland alone, will be truly rectangular, in accordance with practically all modern practice. Work, both in field and office, will become both simple and systematic.

On questions of this nature the Colonial Survey Committee ought to be consulted, since a mistake at the outset of such work has far-reaching consequences, usually irremediable.

12. *Enactments.*—In addition to the Boundaries Settlement Ordinance of 1892, mentioned above, a Bill for an Ordinance to simplify titles and facilitate the transfer of land has been under consideration for some time, but the absence of a general cadastral survey of the island has delayed its introduction.

13. *Engineering Surveys.*—A survey of St. George Harbour was caried out by the Public Works Department and a plan prepared to accompany a report thereon. But, unlike a railway traverse and levelling, for example, the work has little bearing on the survey of the island.

14. *Proposals.*—It is considered that the necessity for a proper survey is urgent, and that a special tax for a period of three to five years ought to be levied to meet the emergency. Postponement will lead to aggravated trouble and augmented tribute.

(*b*) St. Lucia.

1. *Description.*—St. Lucia is an island covering about 230 square miles. The highest hill is Mt. Gimie, culminating at about 3,150 feet. Conspicuous cones, the Gros Piton and Petit Piton on the south-west coast, sweep down to the sea from about 2,500 feet. The island is well watered and has some fine anchorages.

Castries, with good wharves, is the chief town and port. Admiralty charts 197 and 1099 show the principal harbours and bays.

2. *Fundamental Positions.*—The longitude was fixed telegraphically by Lieutenant Havergal from Bridgetown, Barbados, the longitude of which was itself determined telegraphically by Lieutenant-Commander Green, U.S.N., in 1876. In terms of this value the north-east corner of the Verandah of the Iron Barracks on Morne Fortuné, south of Castries, is in latitude 14° 0′ 12″.1 N; longitude, 60° 59′ 56″.7 W.

3. *Trigonometrical Survey.*—A trigonometrical survey of the island was carried out by the Admiralty in 1887–88. Particulars of this survey have been supplied by the courtesy of the Hydrographer and have been transmitted to St. Lucia.

The mean error of an angle, as derived from the closures of the triangles by means of Ferrero's international formula, is ± 1″.2, so that the work was good. The two measures of bearing exhibit an excellent accordance, the discrepancy being 6″ only.

It is not known whether the trigonometrical stations are generally recoverable.

4–6. *Traverses.*—There are no main or minor traverses tied to trigonometrical control.

7. *Topography.*—The land forms are delineated on Chart No. 1273, on the scale of 1 sea mile/1 in.—about 1/73,000. This excellent chart by Lieutenant Havergal, and those previously mentioned by Staff-Commander Parsons and Lieutenant Havergal, exhibit the relief in the usual way by hachures. The heights of all the principal summits are indicated and apparently little is wanting except contouring and the revision consequent on the lapse of years to make the map complete for its scale. The " map " by Jefferys is a characteristic production, in which the place names are about the only recognizable elements of the cartography.

8. *Cadastre.*—Lefort de la Tour, the French Surveyor-General, in 1787, had prepared a Reference Book and plan of the sub-division into estates. The greater part of the island is owned by proprietors whose title dates back to the French occupation; a very small percentage of these estates has been resurveyed.

The Government now surveys estates, in many cases disconnected, which were originally held by the French Government either by right of conquest or reversion. The plan of an estate surveyed by the present Government serves only as an office record for plotting thereon any portions dismembered.

9. *Cadastral Methods.*—Before 1907 the compass was employed to indicate the true meridian. From that date the Government tried to rectify the errors caused thereby; allotments were resurveyed and new grants were issued.

From 1907 onwards surveys were conducted by theodolite traverses, referred to true meridian by astronomical observations. The closing error permissible is 1/700, but in practice 1/1,500 is not exceeded.

All roads traced and constructed since 1907 have been surveyed; but, as the main road which they enter has not been traversed during the British occupation, the plans made from these road surveys merely indicate the quantity of land acquired from the proprietors whose estates they cross.

10. *Need for Revision.*—A general cadastral survey, on a systematic basis, could be carried out with benefit both to individual owners and to the Government, provided, of course, that an accurate framework were in existence. In this work plans executed since 1907 could be incorporated without the necessity for resurvey.

No difficulties have arisen as to boundaries of properties which have been secured by long prescription.

11. *Plans, Records and Title.*—Every Surveyor is compelled to lodge, within 60 days from date of completion of survey, a plan, field notes and report, in accordance with Section 12, Ordinance No. 47 of 1916.

To establish new titles the Government undertakes the survey of an estate according to the above-mentioned plan of Lefort de la Tour, and institutes proceedings as soon as the plan is lodged. At the end of these proceedings title is vested in the Government by order of the Royal Court, the security (apart from the survey) being thus probably the best possible. The next procedure is to dismember the estate according to application.

When the purchase money has been paid in full two Crown Grants are prepared, on each of which there are shown the data on plan of allotment, a recital detailing area and every traverse line. These Grants are signed by the Administrator and countersigned by the Commissioner of Crown Lands. One is issued to the purchaser and another is kept as an Office record; the Grants are registered in the Office of Deeds and Mortgages and are treated as any other deed.

Apart from the " recital " above, wherein the method of detailing may or may not be subject to criticism, the procedure outlined above conforms to the general tenor of the best modern practice; but it appears to be applicable to Crown Lands and

escheated properties alone. Further, the preliminary procedure of formal resumption by the Government may be unnecessary in some countries and in larger Colonies might be cumbrous and not readily adaptable to the prevailing conditions. Nevertheless, the procedure in St. Lucia should repay study and comparison say with the Torrens system in the Australasian Dominions.

12. *Enactments.*—The present Ordinances governing sale, sub-division and other matters connected with land bear the numbers 45, 46 and 47 of 1916. Rules and Regulations have been revised and are now the guides to the methods to be followed by the surveyor in field and office.

13. *Other Surveys.*—A few military plans are on record in St. Lucia; they refer to the country around Castries, and would be of use in a large scale topographical survey.

(*c*) St. Vincent and the Grenadines.

1. *Description.*—The Grenadines form a chain of islands between Grenada on the south and St. Vincent on the north. Of the principal islands—Carriacou, Union I, Cannouan, Mustique and Bequia—the first pertains to the Government of Grenada, but the islands in general are under the St. Vincent administration. The charts 2821, 2872, 791 and 503 show that they possess some good anchorages.

St. Vincent has an area of about 150 square miles. Its mountain axis running north-south, as more or less in the Lesser Antilles generally, is marked by a series of summits attaining to nearly 3,500 feet as an average. On the north is the Soufrière, whose old outer rim, north of the present crater, culminates at over 4,000 feet. This great volcano, violently active in 1812 and 1902, encloses a crater lake about half a mile in diameter and nearly 2,000 feet over sea level.

The mean temperature is 79° F., and the annual precipitation is 70–90 in. in normal localities. Great hurricanes swept over the island in the years 1780, 1798 and 1898.

Sugar, cocoa, Sea Island cotton, arrowroot, rum and timber are the exports of this remarkable island, which possesses sufficient water power to drive its own industries.

2. *Fundamental Positions.*—The position of Georgetown Church appears to be most accurately fixed as regards longitude. This position is given as: Latitude 13° 16′ 38″ N., longitude 61° 07′ 32″ W. The latitude of Porter's Pier, Kingstown, is, however, the basis of the fixing of the latitude of Georgetown and must accordingly be regarded as the more accurate latitude.

3. *Trigonometrical Survey.*—A series of readings were made from proposed trigonometrical points in the southern part of the island. Though these measures are apparently on record, as far as can be gathered from the statement of the Colonial Engineer, the triangulation was never connected to a base. There is thus no trigonometrical control; the stations are in a bad state of preservation, some entirely missing; they would have to be marked, beaconed and observed anew in order to be of value.

In the northern part of the island, north of the line from Chateau Belair to Black Point, a triangulation was executed by Lieutenant A. Havergal, R.N. The naval officer himself did not regard this triangulation as very satisfactory, and has given little information regarding it except such as may be found on his diagram, a reproduction of which has been forwarded to St. Vincent, together with his notes. The work may be regarded as sufficiently good for topography on the comparatively small scale of the Chart, but would evidently be useless for cadastral or engineering purposes.

4–6. *Standard Traverses.*—There is no framework of traverses which could be called standard.

7. *Topography.*—Our topographical knowledge of the island is derived from Chart 791, showing the results of the surveys by Parsons in 1863 and Havergal in 1889.

An edition of this map, with small corrections up to 1898, has been prepared by the Admiralty for the Colonial Office. This map, in somewhat lighter hachures than the chart proper, appears to show the general forms of the land with undiminished clarity. The scale is 1 in./1 sea-mile, *i.e.*, about 1/73,000, and may be considered sufficient for geographical purposes.

The absence of a contoured topographical map on a larger scale is felt by the Public Works Department chiefly. It is pointed out that, with a rainfall during storms approaching two inches per hour in mountainous country, the provision of ample drainage becomes a big problem, involving much money. Further, the provision of water supply to towns, the economical laying out of roads and by-ways, the disposal of town sewage and the harnessing of streams for power all call for the utmost care in the preliminary stages if excess of capital expenditure and recurrent excessive expense of upkeep are to be avoided. These works, executed under present conditions, are apt to carry any initial errors far on into the future, when rectification becomes costly or impossible.

It is apparent that the heavy rainfall is changing the natural features of the island; the surface soil of the higher land is being washed down into the valleys and thence out to sea. The recent development of produce, which has the effect of disintegrating

the soil, has aggravated this wastage and is attracting serious attention in several quarters. Accurate topographical information, particularly as to levels and minor features, must be put in evidence before such problems as these can be studied profitably and the difficulties faced successfully.

The economic situation, thus admirably outlined by the Colonial Engineer in so far as it is the effect of climate, configuration and constitution of the soil, must involve similar problems in other West Indian Colonies and, *mutatis mutandis*, obviously calls for similarly serious consideration.

8. *Cadastre.*—An early and doubtless at the time very useful attempt at a cadastral map was made by John Byres, Chief Surveyor in 1776. This map, of which some sort of " corrected " edition was prepared in 1887, is on a scale of 2 in./1 mile. It shows the situation and general shape of the original states and the reservation granted to the Caribs by the treaty of 1773; the general outline compares very favourably with the Admiralty survey, but the central relief is shown by imaginative hachures; doubtless the central features were then barely known. Apart from historical value, it is of little use save as a mere index; it is too old and of too small a scale to be employed to any considerable extent nowadays. All information required now is taken from the surveyors' original plans, which show principally the boundaries of the estates.

9. *Cadastral Methods.*—Surveying in the Colony appears to have been done to meet local needs simply. Such needs involved the traversing of the estate for the owner, surveying an area for cutting up into small holdings, traversing a route for drainage or road construction, and the like. The system in vogue has been the following.

A bearing on true north has been established at a point some years ago and, in course of time, this bearing has been carried from one survey to another, through various cultivated portions of the island, chiefly along valleys and the coast line; the central part, being very mountainous, has been left alone. The present Authorities are unaware if it was originally intended to set any limit to this excessive prolongation of bearing, uncontrolled as it is. Regulations now require the observation of the true bearing of a line in every survey, either solar or stellar methods being employed. The stations were in general marked by hardwood pegs; consequently many of the older marks are no longer traceable, though a large number of old plans are in existence in the Crown Surveyor's office in Kingstown.

No information appears to be available regarding the instruments used in former times. At the present day traverses are run by means of the theodolite, and estates are surveyed in the same modern way. There is no general cadastral survey except such as may be considered to be made up of the aggregate of the surveyors' plans.

10. *Boundaries.*—Occasionally disputes arise between small occupiers concerning boundaries or rights of way.

11. *Records and Title.*—The boundaries and area of a property are recorded on the surveyor's plan; this is the only record, which is filed away as such. A copy of the plot, with survey information, is traced upon the Title Deed and thus forms the index to title, which is registered and filed by the Superintendent of Crown Lands.

12. *Regulations.*—The enactment governing the procedure of letting or sale and controlling Land Surveyors is embodied in the Crown Lands Ordinance No. 4 of 1906. Rules for the guidance of the Surveyor were made by the Governor in Council on 12th August, 1919. These might well be consulted by neighbouring Colonies about to draw up or modify their regulations.

13. *Engineering Surveys.*—These are carried out in general by the Colonial Engineer; any which would be of value for general surveys are thus immediately accessible.

COLONIAL REPORTS, ETC.

The following recent reports, etc., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	*Colony, etc.*	*Year.*
1196	Turks and Caicos Islands	1922
1197	Nigeria	1923
1198	Weihaiwei	"
1199	Gilbert and Ellice Islands	1922–1923
1200	Ashanti	"
1201	Gambia	1923
1202	Bahamas	1923–1924
1203	Hongkong	1922
1204	Nyasaland	1923
1205	Cayman Islands	1922
1206	Cyprus	1923
1207	Gold Coast	1922–1923
1208	Trinidad and Tobago	1923
1209	Zanzibar Protectorate	"
1210	Bechuanaland Protectorate	1923–1924
1211	Swaziland	1923
1212	Basutoland	1923–1924
1213	Turks and Caicos Islands	1923
1214	Fiji	"
1215	British Honduras	"
1216	New Hebrides	"
1217	Gibraltar	"
1218	Jamaica	"
1219	Sierra Leone	"
1220	Uganda	"
1221	Grenada	"
1222	British Guiana	"
1223	St. Vincent	"
1224	St. Helena	"
1225	Barbados	1923–1924
1226	Somaliland	1923
1227	Kenya Colony and Protectorate	"
1228	Hongkong	"
1229	Northern Territories of the Gold Coast	1923–1924

MISCELLANEOUS.

No.	*Colony, etc.*	*Subject.*
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments, etc.
85	Southern Nigeria	Mineral Survey, 1911.
86	Southern Nigeria	Mineral Survey, 1912.
87	Ceylon	Mineral Survey.
88	Imperial Institute	Oilseeds, Oils, etc.
89	Southern Nigeria	Mineral Survey, 1913.
90	St. Vincent	Roads and Land Settlement.
91	East Africa Protectorate	Geology and Geography of the northern part of the Protectorate.
92	Colonies—General	Fishes of the Colonies.
93	Pitcairn Island	Report on a visit to the Island by the High Commissioner for the Western Pacific.

Printed by H.M.S.O. Press, Harrow.

COLONIAL REPORTS—ANNUAL.

No. 1286.

REPORT

OF THE

COLONIAL SURVEY COMMITTEE

1925.

(For previous published Reports see No. 828—Cd. 7622–19, price 2½d., and No. 1230, price 2s. 6d.)

LONDON:
PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
Adastral House, Kingsway, London, W.C.2; 28, Abingdon Street, London, S.W.1;
York Street, Manchester; 1, St. Andrew's Crescent, Cardiff;
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1926.

Price 1s. 0d. Net.

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No. 1286.

COLONIAL SURVEY COMMITTEE REPORT, 1925.

The period reviewed varies according to whether the reports received from the Dependencies concerned cover the year ending 31st December, 1923, or 31st March, 1924.

No reports have been received from Nigeria for the years 1920–1923. Reports covering the years 1914–1919, which had not been received when the previous Report was issued, have been reviewed in this issue of the Report.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

W. C. BOTTOMLEY.
E. M. JACK, *Colonel, D.G.O.S.*
H. S. L. WINTERBOTHAM, *Colonel, General Staff.*
H. P. DOUGLAS, *Captain R.N. & Hydrographer of the Navy.*

G. T. McCAW.
P. LIESCHING. } Secretaries,

March, 1926.

(21104) Wt. 25060/1826 625 4/26 Harrow G.94

British Honduras, 1923–24.

Governor	... ...	Sir Eyre Hutson, K.C.M.G.
Surveyor-General	... ...	Mr. F. W. Brunton.

Staff.

Surveyor-General.	3 Clerks.
4 Surveyors.	2 Inspectors of Crown Leases.
1 Draughtsman.	1 Messenger.
1 Tracer.	

Revenue and Expenditure.

Expenditure.	£	Revenue.	£
Personal Emoluments ...	3,410	Royalties on Timber...	5,900
Travelling Expenses ...	320	Petty Licences ...	50
Expenses of Surveys ...	650	Rent of Crown Lands	2,550
Instruments and Drawing Materials	610	Sale „ „	340
Collection of Rents ...	40	Miscellaneous ...	20
Miscellaneous	70		
Total Expenditure ...	£5,100	Total Revenue ...	£8,860

The improvement in the Revenue was due to appreciation in the price of mahogany.

Trigonometrical and Topographical Surveys.

None.

Cadastral.

An area of 2,016 acres comprising 95 parcels of land in Belize, Stann Creek, Toledo and Corozal Districts was surveyed.

Traverses aggregating about 12 miles in length were completed, including 3 miles of boundary line re-surveyed and marked.

A preliminary survey was made of the recently reclaimed area at Fort George, Belize, and a survey of Young's Pond, Belize river, was undertaken in connection with the proposed water supply of Belize.

Levelling.

Some assistance in Belize was rendered to the Public Works Department and the Town Board for the purpose of reclamation.

Maps and Plans.

No new maps were published during the year. Eighty-five plans were made for grants and leases besides 15 other plans and 40 tracings.

General Remarks.

It has not hitherto been found possible to lay down a definite programme either for the trigonometrical survey which must, eventually, control all other surveys, or for mapping. Fortunately, however, a start is to be made soon with a chain of triangulation from Belize to Garbutt's Falls, and it is to be hoped that from this beginning a definite and consecutive programme will grow.

Ceylon, 1923–24.

Governor	Sir William Henry Manning, G.C.M.G., K.B.E., C.B.
Surveyor-General	Mr. A. J. Wickwar, F.R.G.S.
Deputy Surveyor-General ...	Mr. A. H. G. Dawson.
Assistant Surveyor-General ...	Mr. C. R. Lundie, A.M.I.C.E.
Superintendent, Colombo Observatory.	Mr. A. J. Bamford, B.A.

Sanctioned Staff.

12	Superintendents of Surveys.
1	Superintendent, Colombo Observatory.
37	Assistant Superintendents of Surveys.
2	Astronomers.
3	Junior Technical Assistants, Colombo Observatory.
280	Grade Surveyors.
1	Accountant.
1	Superintendent of the Process & Litho. Depts.
4	Assistant Superintendents (Headquarters).
1	Instrument Repairer.
420	Clerks and Draughtsmen.

Topographical Work.

The area contoured during the period under review was 8,214 square miles. These surveys include portions of the following provinces :—Northern, North-Western, North-Central, Eastern and Central. The field work of the remainder of the Island was to be completed during 1924.

Triangulation.

Topographical Triangulation was carried out (*a*) in the neighbourhood of Kantalai Tank, Eastern Province, observations being taken from twelve stations and the area covered by new points being roughly 30 square miles, and (*b*) in the North-Central and Northern Provinces, observations being taken from thirteen stations and the area covered being roughly 480 square miles.

Triangulation for Block Surveys was carried out in Kandapalla Kirale, Province of Uva, observations being taken from thirteen stations and the area covered being roughly 50 square miles.

Reconnaisssance was completed and observations begun for the connection and extension of existing triangulation in the Pasdun and Kukulu Korales, Western and Sabaragamuwa Provinces, the area covered being roughly 460 square miles.

An area of about 25 square miles in Balangoda, Province of Sabaragamuwa, was reconnoitred for Block Survey triangulation.

Levelling.

A circuit of precise levels was run, 21·6 miles in length around Colombo, and a line of precise levels from Colombo to Puttalam via Negombo and Chilaw was carried forward 61½ miles.

The instruments used were two new Cooke's improved levels (bubbles of angular values of 10 seconds for 1/10 inch division), fitted with Cooke's " speculum " mirrors and micrometer attachments giving direct readings to 0·001 foot : and Watts' 10-foot wooden staves graduated on a central strip of invar.

The levelling was carried out by two Assistant Superintendents of Surveys, but during recess two grade surveyors were trained as additional levellers.

A benchmark party was engaged in constructing benchmarks ahead of the levellers. Two hundred and ninety-four benchmarks were completed and of these 149 were concrete blocks, the remainder being brass bolts cemented into permanent structures.

Block and Settlement Surveys.

The average staff engaged on this work during the period under review was 104 surveyors and 12 Assistant Superintendents of Surveys.

This staff was employed on new Block Surveys, covering an area of 170,064 acres and on surveys at 1/3168 which were plotted on topographical maps. The area so covered was 575,171 acres.

Settlement Surveys were carried out in 70 villages covering about 63,075 acres. Following sale, the boundaries of a number of lots, containing about 316 acres in all, were demarcated, the landmarks being located with reference to former surveys.

Town Surveys.

Town Surveys were carried out over an area of 3,590 acres. An area of about 1,000 acres in Colombo was contoured with a 2-ft. vertical interval.

Application Surveys.

Ninety-two Surveyors were employed on these surveys and 3,728 questions were attended to.

Survey Department Observatory, Colombo.

Transit Instrument.—The Cooke Transit (4-in. object glass) has been in regular use throughout the year, and has given very satisfactory results. In all, 756 stars were observed on 131 days, of which 537 stars on 73 days were in the evening, or early part of the night, and the remainder in the early morning.

Time Signals.—The arrangements for these were similar to last year. The most important were those that released the harbour time ball at 9 a.m., 1 p.m. and 4 p.m. Ceylon Standard Time (*i.e.*, 15½, 19½ and 22½ Greenwich Mean Time) on ordinary days and at 9 a.m. only on Sundays and public holidays.

The Meteorological Service is organized under the Survey Department's Observatory and has shown no lack of activity.

Survey Training School.

Departmental Classes.—Sixteen students received appointments as surveyors during the year. Eight students are in training.

Licence Classes.—There was no Licence Class in the School during the year, as no candidates qualified for admission.

Examinations.—At the annual examination for the Surveyor-General's Licence in Surveying and Levelling, five candidates presented themselves, of whom two were successful and were granted licences in surveying.

Remarks.

The Survey Department has a big organization, from which much must be expected. No information is given of the expenditure of the Department, nor are there any statistical details indicative of the cost of the triangulation and topography per square mile, of traversing and levelling per mile run or of cadastral work per acre. Moreover, there is—with one exception—nothing to indicate the quality or efficiency of the work, technical details being absolutely lacking. Cartography is an exception: the published sheets are of characteristic design and are generally admirable.

Cyprus, 1923–24.

High Commissioner	**Sir Malcolm Stevenson, K.C.M.G.**
Registrar-General and Director of Surveys	**Mr. B. T. Watts.**
Assistant Director of Surveys...	**Mr. P. E. L. Gethin.**

Organization of Survey Department.

Field Survey Section.—No change from previous report except a decrease of 3 Permanent Land Registry Clerks.

Drawing Office Section.—One Surveyor; 16 Permanent Land Registry Clerks; 7 Temporary Clerks; 3 Chainmen.

There are also Valuation and Land Registration Branches, which are not dealt with in this report.

Analysis of Expenditure.

	£	£
Administration, including Stores and Maps ...		1,135
Survey and Cartography—		
1. Fourth-order Triangulation ...	256	
2. Traversing and Village Survey ...	2,354	
3. Plane-table Survey	5,378	
4. Drawing, Plotting and Computing Office	3,230	
		11,218
Valuation and Village Boundaries		2,986
Field Record		1,727
General Registration		1,508
Total Expenditure		£18,574

Trigonometrical Section.

The 4th order Triangulation in the Districts of Nikosia and Papho was carried out by one observer during a period of six months. Five hundred and five points were fixed and observed, 211 square miles were covered at a cost of £256; average cost per point being £0·50; per square mile, £1·21.

Theodolite traverses were conducted in 94 villages of the same Districts; the total chainage being 37,252 ft., at a cost of £25 per village.

Detail Survey.

The Plane Table Survey on a scale of 1/5,000 of the Nikosia and Papho Districts was continued; the area surveyed in both Districts was rough and hilly with many ravines and small holdings. The method employed is a judicious compromise between interpolation from trigonometrical points for position and stadia distance measurement for minor detail.

The total area surveyed was 171,666 acres at a cost of £5,378, *i.e.*, 0·62 sh. per acre or £19·7 per square mile.

Ninety-eight villages, of an average size of 28·25 acres, were also surveyed in the same Districts on a scale of 1/1,250 at a total cost of £2,355 or 17sh. per acre.

No actual topographical survey was made in the field, but the plane table plans at 1/5,000 are being reduced to a scale of 2 in. to the mile.

The contouring is based upon the heights of trigonometrical points and of a large number of plane table interpolations.

The number of large scale plans so reduced was 530.

The examination of the 72 village surveys and 200 plane table sheets was carried out.

Computation, Plotting and Drawing.

All computation was done at headquarters on a " Brunsviga," and included 1,507 trigonometrical heights. A co-ordinatograph is used for plotting. The number of plans drawn was 253. The sole method of reproduction available is sun printing and 2,655 prints were made.

Valuation, Field Record and Registration.

The duties of the Department include valuation for assessment of taxes, the recording in the field of properties and boundaries, together with the assignment and registration of title. During the year, 28,226 title deeds for 14,936 plots were issued, the registration fees amounting to £1,135.

Progress.

The progress of the Survey has been well maintained during 1923–24, although the output of work was less than the preceding year owing to exceptionally wet weather from 15th December to the end of February and to the rough nature of the country under survey.

Administrative and technical efficiency, with ability to present a sufficiency of technical and statistical information, evidently characterize this Department of the present Registrar-General.

Federated Malay States and Straits Settlements, 1923.

Governor of the Straits Settlements and High Commissioner of the Federated Malay States	Sir Laurence Nunns Guillemard, K.C.B.
Surveyor-General	Mr. V. A. Lowinger.
Assistant Surveyor-General, Federated Malay States and Straits Settlements	Mr. C. J. Perkins.
Assistant Surveyor-General, Topography	Mr. J. N. Sheffield.

Staff.

The Staff consisted of a Surveyor-General, two Assistant Surveyors-General and a Field Staff of 43 Europeans, and four Europeans in the reproduction and instrument repairing sections.

In the Unfederated States of Kedah and Johore, an additional Field Staff of 16 Europeans was employed.

FEDERATED MALAY STATES.

Trigonometrical.

The reconnaissance Survey in north-east Pahang was completed and progress made northerly into Trengganu, giving a total area of 935 square miles.

The selecting, clearing and beaconing of the hills in Trengganu, prior to a primary triangulation, was completed.

Topographical.

The principal surveys made during 1923 were :—

Series of Topographical Sheets 2N/10 and 2N/14, including the area " Cameron's Highlands ", suggested as a hill station, 170 square miles in all.

The revision of the 1 in. to the mile sheets 2N/9, 2N/13, 3A/3 and 3A/4.

Large scale surveys, mainly for plans at one or two chains to the inch, executed for the purpose of town planning.

Revenue.

This branch surveyed 11,150 lots for alienation with an area of 207,713 acres. The number of titles prepared was 18,809. At the end of the year approximately 3,650 lots awaited survey.

Photo-Litho.

The total production of copies of maps and lithos amounted to 373,526. Approximately 2,000,000 coupons were printed in connection with rubber restriction.

Instrument Repairing.

All departmental instruments were kept in repair, as well as many scientific instruments of other local departments. With the exception of theodolites and levels, practically all the instruments used by the topographical parties are now being made by the instrument repairing branch.

Cost.

The total expenditure was $1,515,779; reimbursements and revenue amounted to $309,749, leaving a net expenditure of $1,206,030.

STRAITS SETTLEMENTS.

Trigonometrical.

Ninety-three miles of rigid standard traverse were surveyed, and 564 permanent marks emplaced. Fourteen trigonometrical stations were occupied, all in Malacca.

Topographical.

The 4 in. to the mile survey of Singapore Island was completed, 81 square miles being surveyed.

Revenue Survey.

Five thousand one hundred and fifty-eight lots (55,572 acres) were surveyed. These figures are abnormal owing to the inclusion of the revision survey of Malacca.

It has been found necessary entirely to resurvey the alienated lands in the Settlement of Malacca; this work is proceeding rapidly, *vide* tabular statement following.

Cost.

The expenditure amounted to $487,110 of which $113,123 was special expenditure mainly connected with the revision Survey of Malacca. By deducting revenue, $52,394, the net expenditure becomes $434,716 ($1 = 2*s*. 4*d*.)

Topographical Branch—1923.

Federated Malay States and Straits Settlements.

Situation.	Scale.	V.I.	Area.	Monthly Output per Plane Table.	Cost.	Cost per Square Mile.
	1 to	Ft.	Sq. Miles.	Sq. Miles.		
					$	$
Singapore	15,840	25	81	0·84	43,632	537
Pahang and Perak ...	63,360	50	150	1·7 to 2·8	52,249	128 to 380
Singapore, Kalang Town planning.	792	—	0·071	—	1,455	20,500
Perak and Selangor ...	1,584	5	2·251	0·042 to 0·147	9,660	3,832 to 6,831
Selangor Scheme 20 ...	792	5	0·675	0·039	5,591	8,283
S.S., Dindings	3,168	10	0·516	0·103	1,512	2,930

Revenue Surveys—1923.

Straits Settlements.

(For the 208,000 acres in the Federated Malay States the corresponding figures are not available.)

The progress in the resurvey by modern methods of the alienated land in the three Settlements is shown in the following table, which marks an all-round increase.

State.	Lots.	Area.	Chainage.	Cost per Chain.	Total Cost.	Cost per Acre.
		Acres.	Chains.	Cents.		
					$	$
Singapore	1,373	2,463	46,448	78	36,412	14·8
Penang	2,072	6,176	46,128	97	44,957	7·3
Malacca (Thdl.)	1,713	46,933	92,227	56	51,185	1·09
Malacca (Comp.)	8,441	12,333	97,393	17	16,339	1·24
Total, excluding Compass Surveys.	5,158	55,572	184,803	72	132,554	2·68

COMPARATIVE RETURN OF EXPENDITURE—1923.

	Federated Malay States.		Straits Settlements.	
	$	$	$	$
Personal Emoluments	919,155			256,199
Temporary Allowances	127,564			
		1,046,719		
Clerical Services		34,879		
Field Allowances	111,311		28,331	
Survey and Demarcation ...	280,831		64,105	
Instruments and Materials ...	31,139		7,304	
Contingencies	5,257		426	
Overhead and Miscellaneous ...	5,643		17,021	
		434,181		117,187
Special Expenditure (Singapore and Malacca)				113,724
Gross Expenditure		$1,515,779		$487,110

Gold Coast, 1923–24.

Governor	Brig.-Gen. Sir F. G. Guggisberg, K.C.M.G., D.S.O.
Surveyor-General ...	Lt.-Col. R. H. Rowe, D.S.O., M.C., R.A.
Deputy Surveyor-General	Mr. J. Clendinning, B.Sc.

Organization.

The organization remained essentially the same with the addition of a special Cadastral Framework party.

Topographical Branch.

Two hundred and twenty miles of theodolite traverse and 560 miles of levelling were completed. Seven thousand square miles were surveyed on a scale of 1 : 62,500, making a total area surveyed on this scale of 24,000 square miles.

Cadastral Branch.

The Town Survey of Accra on the scale of 1 : 1,250 was completed; that of Keta was commenced and the field work completed. Fifty-six other surveys were dealt with, together with a number of boundary and land disputes. Existing triangulation was examined with a view to further observation, some reconnaissance for further extension was made and a new base was measured.

The Special Cadastral Framework Section was formed to provide a reliable framework adjusted to form one complete system on which local surveys can be based and to which isolated surveys can be connected. The party consists of two surveyors and one computer. The accuracy of the traverses executed by the party will, it is hoped, be of a high order. Legs are measured in a manner practically identical with that used in base measurement. The 300-ft. tapes are suspended in catenary, supported at 100 and 200 ft. on intermediate tripods and used at a pull of 20 lb. Angular measurement is done with a 5-in. micrometer microscope theodolite and the common arrangement of 3 tripods for instrument and station signals is employed.

Observations for Azimuth are taken at frequent intervals (not more than 30 stations apart).

Every station is permanently marked and, in addition, concrete beacons in sets of three (the outer ones being visible from the centre one) are erected every three miles. Two bearings and the included angle are thus preserved on the ground. With six weeks actual work 34 miles of traverse were run and a rate of 30 miles a month is expected in the future.

Records and Reproduction.

Sixteen sheets of the 1 : 62,500 Series, 34 sheets of Takoradi and 11 more sheets of the Accra Town Surveys have been reproduced. A revised edition of the 1 : 500,000 diagrammatic road map was also printed. A large amount of reproduction, including 40,000 small-scale maps, was undertaken for the British Empire Exhibition.

Survey Schools, etc.

Forty-three African Surveyors were under training, one batch being due to pass out in June, 1924. Two pupils passed out in June, 1923. A much improved type of native is now coming forward. At Headquarters 32 native draughtsmen, lithographers, etc., were in training.

Details of Costs.

Topographical Survey.—The following table shows the comparison between the figures of the previous season with those of a normal camp and a " native " camp during the current season. In the native camp the only European was a supervising officer.

	1922–23.	1923–24.	
		Normal Camp.	Native Camp.
	£ s. d.	£ s. d.	£ s. d.
Detail Survey per 1-inch sheet of 290 square miles	650 0 0	556 0 0	356 0 0
Cost per traverse mile	1 5 0	1 1 5	0 14 0
Cost per square mile	2 15 10	1 18 4	1 5 0

The economy effected by the employment of African Surveyors is obvious.

Cadastral Survey.

No appreciable change occurred in the cost of rigorous traverses through bush country. In open country or when no cutting was necessary the average cost was £11 5s. per mile.

Compass traverses average £3 10s. per mile.

Hongkong, 1923.

Governor ... ... Sir R. E. Stubbs, K.C.M.G.

Director of Public Works—
January to May ... Mr. T. L. Parkins.
August to December ... Mr. H. T. Creasy.

Superintendent of Crown Lands ... ... Mr. L. C. P. Rees.

Organization.

The Crown lands and Survey Office forms a branch of the Public Works Department, and deals with all matters relating to Crown lands.

There are two principal land Surveyors in charge of the Survey work in Hongkong, and in Kowloon and New Territories respectively. They are responsible for all surveys (except "Ordnance Survey" as described later) in their respective districts.

The Staff is as follows :—

Field:

16 European Surveyors.
3 Chinese Assistant Surveyors.
7 Chinese Apprentice Surveyors.
A number of Chinese student Surveyors.

Office:

1 European Chief Draughtsman.
11 Chinese Draughtsmen.
1 European Clerk.
5 Chinese Clerks.
2 Chinese Computers.

There are also 4 Land Bailiffs and 84 Survey Coolies.

Trigonometrical Work.

A trigonometrical station was fixed at Laichikok from the existing triangulation.

Topographical and Cadastral Surveys.

About 59 acres in Hongkong were surveyed and plotted.

The portion of Stubbs road between Magazine Gap and Peak Church, and the centre line of the proposed road on the 200 ft. contour at North Point were surveyed and plotted.

Contour surveys of an area of about 30 acres at Laichikok for the proposed site of a lunatic asylum, and of seven acres at Waterloo Road were carried out. An area of about 26 acres at Castle Peak was partly surveyed and plotted on the " Ordnance " sheets. Main traverses were run between Jordan Road, Tai Kok Tsui and Laichikok Taig Stations. Some setting out work in connection with town planning schemes and erection of monuments to define the centre line of proposed roads was carried out.

Revenue Surveys.

The applications for purchase of land continued to increase during the year, and most of the Surveyors' time was taken up with surveys in connection with building sites, preparation of lease plans, etc. Surveys were made for sale purposes of 60 lots covering an area of 2,994,349 sq. ft. Schedule and plans were prepared for exchanges of about 125 lots.

" *Ordnance Survey.*"

The nature of this survey is not indicated, but it appears to be a survey for the provision of an accurate standard map of the Colony. The work of training Chinese student Surveyors was continued under a European Surveyor. The number at present employed is 10.

A portion of the Western District of the City, containing about 177 acres, was surveyed in detail, of which 147 acres were plotted on the " ordnance " plans.

Maps.

No maps were published during the year.

Miscellaneous Matters.

The following plans were prepared for official use during the year :—146 lease plans (in triplicate), 58 sale plans (in duplicate), 356 tracings and 5,262 sunprints. 1,594 permits for temporary occupation of Crown lands, and 61 licences for temporary piers and slipways were issued.

Costs.

If there are omitted such items as lighting, heating, electric fans, etc., the charges for which cannot be stated owing to the office forming part of the Public Works Department, the cost was $153,002.

Remarks.

As heretofore, the report contains no technical or statistical details whereby the standards of accuracy and the efficiency of the work may be estimated.

It is believed from the evidence of certain topographical measures recently undertaken by a Colonial Survey Section R.E. that the most important duty which faces the Survey Department at the present time is the re-observation and re-marking of the trigonometrical survey.

Jamaica, 1923.

Governor	...	Sir Leslie Probyn, K.C.M.G.
Surveyor-General	...	Mr. W. A. Baker.

Staff.

1 Surveyor-General.
1 Assistant Surveyor-General.
2 Surveyors.
5 Clerks.
1 Draughtsman.

Expenditure.

The total expenditure for the year amounted to £5,658. Of this £743 is accounted for under " Surveys."

Revenue.

The total revenue amounted to £7,613.

Triangulation.

None was carried out during the year.

Traverse Survey.

A total of 90¾ miles at a cost of £8 per mile was traversed. The errors of these traverses, mostly closed, ranged between one in 300 and one in 9,000.

Topographical Survey.

None carried out.

Maps.

No progress has been made in either the 1-in. to 1-mile map of the whole Island, or in the map of the Liguanea Plain.

General Remarks.

The report for this period emphasizes more and more that the department has become essentially a Land Record Office. The lack of a trigonometrical framework and of reliable cadastral and topographical maps of the Island does not yet seem to have been noticed. The plans deposited by licensed surveyors are annually becoming worse. This year 55 per cent. were rejected on theoretical checks alone.

It is satisfactory to note that the Surveyor-General has published this year's report on the lines suggested in the Colonial Survey Committee's report for the period ending 31st March, 1923*. On the other hand, the report clearly proved that the state of the surveys in Jamaica is, in general, a century behind the standard of Europe.

Nigeria, 1914.

Governor	Sir F. J. D. Lugard, G.C.M.G., C.B., D.S.O.
Surveyor-General ...	Major F. G. Guggisberg, R.E., C.M.G.
Officer-in-Charge of Special Minefields Surveys ..	Capt. F. L. N. Giles, R.E.
Deputy Director of Surveys, Southern Provinces	Mr. A. Cleminson.
Deputy Director, Topo. Branch, Southern Provinces	Capt. R. H. Rowe, R.A.
Chief Surveyor, Northern Provinces	Mr. A. S. Collard.

* No. 1230 (1924) in the Colonial Annual Reports Series.

Owing to the war and military operations in the Cameroons, the Staff was greatly depleted in the latter half of the year. One officer, Lieut. H. H. Schneider, R.E., Special Reserve, was killed in action in the Southern Cameroons on 5th December, 1914.

Southern Provinces.

On the outbreak of war the Topographical Branch and the Minefields Section were reduced to their native staff, and the Special Party of N.C.O.s, who were engaged on the detail survey of Lagos, left the Cadastral Branch. Accordingly, the latter was reorganized and the native staffs of the other branches were put on the Lagos Town and other special work, for which they showed powers of adaptation. The depleted European staff continued cadastral work in the Provinces.

Topographical Branch.

Work was confined to the extension of the Naraguta triangulation, which forms the basis of the topography along the route of the new railway.

Cadastral Branch.

The output of work was much in excess of that of any previous year, but owing to the special conditions no useful statistics of cost could be furnished. Thirteen sheets of the 1/1056 survey of the Lagos Municipal Area were completed and sent to England for publication, and many plans for various purposes were prepared. Apart from the Lagos Detail Survey, the principal work undertaken included :—Government Stations and Reserves, &c., traverses for town alignment, Lagos water assessment Survey, District boundaries traders' plots and revision surveys.

School.

Until August, indoor and field tuition work was carried on by Serjt. Wharton, R.E.; later the Chief Native Surveyor acted as instructor, in addition to his other duties. It is unfortunate that, while at the end of 1913 there were at work in this Department 15 out of 19 pupils, at the end of 1914 only 10 remained out of 25 who had passed through the course.

Maps.

Fifteen sheets on the 1/1056 scale were received from the publishers during the year.

Northern Provinces.

Mines.

Exclusive Prospecting Licence areas surveyed, 33·76 square miles.

Areas under Mining Licence surveyed, 2,087 acres.

Lengths of Stream Mining Lease surveyed, 2 miles.

Other Work.

Revision of Town Plan of Kaduna on scale 1/4,800.

Reproduction of Town Plan of Kaduna on scale 1/12,500.

Town Plans of 50 Government Stations, 69 railway stations and special surveys.

Ten sheets for Kano water supply on scale 1/4,800.

Fourteen sheets compiled of map of Northern Provinces, on scale 1/250,000.

Maps of Northern Provinces, showing boundaries, produce of provinces, Native Courts and roads for 1914, on scale 1/1,000,000.

Map of Northern Provinces, showing distribution of game, on scale 1/2,000,000.

School.

The school was under officers of the Political Department until August and special attention is drawn to the success of Mr. Middleton, acting as Instructor, although he was not a trained Surveyor. In August Mr. Morphy of the Survey Department took charge and at the end of the year the work of the surveyor and pupils was of a high standard.

Nigeria, 1915–19.

Governor, 1914–1919	...	Sir F. J. D. Lugard, G.C.M.G., C.B., D.S.O.
Governor, 1919 ..	...	Sir Hugh Clifford, G.C.M.G.
Deputy Director of Surveys, Southern Province	...	Mr. A. Cleminson.
Acting Chief Surveyor, Northern Province	...	Capt. T. J. Waters.

SOUTHERN PROVINCE.

Owing to the outbreak of war the Survey Staff was so seriously depleted that all the remaining staff engaged in the topographical branch were withdrawn and added to the Cadastral Branch. During the period under review, then, work was almost entirely confined to Cadastral surveys, enabling the work of this branch to be brought up to date.

Topographical Survey.

In 1918 several road traverses were run, joining up isolated Cadastral Surveys.

The Lagos Lagoon was also re-triangulated with greater precision.

In 1919 a party of four surveyors started work, at the request of the Geological Surveyor, on the Apiam Field Sheet, but it was not completed by the end of the year.

Cadastral Survey.

1915—The main work undertaken was the continuation of the detail survey of Lagos. Primary traverses for the extension of the detail survey up to Ebute Metta were also executed, together with 10 Government Stations, 36 plots and other smaller surveys.

1916—Work was continued on this extension and in addition, the demarcation of the lay-out of Port Harcourt was completed. A start was made on the detail survey of Abeokuta and primary traverses were run at Ibadan and Onitsha so as to provide a framework for detailed surveys. Eighty-three plots were also surveyed.

1917—The Survey of Port Harcourt was completed and those of Ibadan and Onitsha commenced. The survey of Abeokuta was continued and was almost half finished by the end of the year, while that of the Jebu Ode reservation was completed. Sixty plots for leases were also surveyed.

1918—As opportunities occurred progress was made with these uncompleted surveys. In addition 1,678 plots and 10 farms, the latter covering an area of 11,000 acres, were surveyed.

1919—Six framework traverses, six detail surveys of towns and 1,613 plots were included in many miscellaneous surveys carried out.

Maps and Plans.

In 1915, 36 sheets of the 1/1056 series of Lagos were printed and a 6-sheet map of Lagos and environs on a scale of 1/12,500 was completed. Two thousand four hundred and ten plans, tracings and sunprints were made.

In 1916 the 1/12,500 map of Lagos and environs was redrawn in 8 sheets ready for publication. Two thousand one hundred and sixty-two plans, etc., were made.

During 1917 and 1918, in co-operation with the Northern Province, progress was made in the 16-sheet series, on a scale of 1/500,000, of the whole Protectorate.

In 1917, 1918 and 1919, the following plans, etc., were made : 3,114, 1,984, 2,067.

Astronomical Survey.

In 1916 a Longitude determination of Duala, by telegraphic exchanges of time with Lagos, was made. The resulting Longitude of Duala was 9° 41′ 24·75″E.

In 1917 the Longitude of Port Harcourt, the same method being used, was found to be 7° 0′ 43″E.

Survey School.

Up to 1917 the School was continued under the senior native Surveyor, practical training being given by attaching pupils to parties working in the field.

Expenditure.

The cost of the department for the years under review was as follows :—

	£
1915	16,752
1916	12,063
1917	10,524
1918	9,649
1919	No figure given.

NORTHERN PROVINCE.

The work of this department was seriously impaired by the demands of active service, yet a fair amount of work has been done.

Triangulation.

In 1919 an extension of the Minefield triangulation was undertaken in order to fix new areas in outlying districts. Nineteen new stations were occupied.

Cadastral Survey.

The following table shows the surveys carried out during the period under review :—

	Government Stations.	*Railway Stations.*
1915	8	14
1916	13	4
1917	5	1
1918	1	1
1919	1	1

Mines Party.

The following work has been carried out :—

	Exclusive Prospecting Licences.	*Mining Leases.*
	Square Miles.	*Acres.*
1915	37	11,547,550
1916	51	13,357
1917	140	9,449
1918	88	7,123
1919	211	5,263

and in addition 3 Stream Mining Leases, totalling 3 miles, and 1 Lode Mining Lease of 1,200,000 sq. ft.

Native Revenue Section.

This section was formed in 1918 to supply, amongst other things, large scale maps showing individual farm holdings and areas; it also compiled district and province maps, showing roads, streams, etc., pending a precise topographical survey.

The methods used are compass traverse, chain and offset. The degree of accuracy allowed is 1 : 300 and that attained averaged 1 : 550.

At the end of 1918 some 20 square miles had been surveyed, while during 1919, 5,956 farms, covering 15,492 acres, were completed.

The farm surveys have resulted in the production of a map of Kano and district on a scale of 1/31,250.

Survey School.

The total number of native Surveyors, pupils, etc., on the rolls at the end of 1919 was 75—an increase of 21 over the previous year. The pupils are divided into two categories : (*a*) Government Survey pupils and (*b*) Native Administration pupils.

The senior class are given practical instruction by executing actual surveys. A considerable amount of detail and contour work was done by them in and around Kano. Two assisted the mines party and one is making a compass traverse of the Kaduna–Lucia Road. Other roads were also surveyed or being surveyed. The progress made was very satisfactory.

A preparatory School has also been formed where new pupils receive instruction—normally for one year—in Reading, Writing and Arithmetic. The pupils of the Senior Class of this School normally belong to the junior Survey Class also.

Maps, etc.

The 16-sheet series of the 1/500,000 map of the Protectorate was completed in 1919.

The following table shows the production of drawings, sunprints, etc., for the period :—

	Drawings, etc.	*Sunprints.*
1915	332	2,923
1916	266	2,447
1917	314	4,036
1918	324	3,621
1919	332	3,460

Revenue and Expenditure.

Information concerning the Minefield Party only has been given. The comparison is as follows :—

	Cost.	*Fees Charged.*
	£	£
1915	—	2,954
1916	2,223	3,176
1917	2,287	3,702
1918	2,427	3,418
1919	3,451	4,875

Northern Rhodesia, 1923–24.

Governor ... ... Mr. H. J. Stanley, C.M.G.
Chief Surveyor ... ... Mr. W. G. Fairweather.

Staff.

6 Assistant Surveyors.
4 Chain Boys.
1 Typist.
1 Messenger.

Trigonometrical Survey.

While there is no main triangulation covering the whole country there are many isolated surveys, together with part of the African Arc of Meridian now connected to Uganda by a secondary chain.

During the year minor work carried out west of Lusaka resulted in the connecting up and adjusting of several of the detached nets of triangulation.

Cadastral Survey.

Farm Surveys were carried out at Kalomo, Choma, Magoye, Mazabuka, Chilanga, Lusaka, and Chisamba. Altogether 68 farms covering an area of 177,322 acres were surveyed at a cost of £3,628.

Seventy-three small plots covering 398 acres at a cost of £403 were also surveyed.

Traverse Surveys.

Traverse Surveys were carried out along the Zambesi river in connection with application for land, and also along certain roads in the Lusaka and Choma areas.

Topographical Surveys.

Only such as could be carried out in conjunction with the Farm surveys were done during the year.

Maps.

The 1/1,000,000 map of the territory has been reprinted. The map is not printed in colours and any colouring shown has been done by hand.

The 1/250,000 series, each sheet covering $1\frac{1}{2}^{\circ}$ longitude and $1\frac{1}{4}^{\circ}$ latitude, has been almost completed. These sheets are continually being revised and corrected as more reliable information becomes available.

General Remarks.

The lack of a general trigonometrical framework and a reliable topographical survey, so essential to a progressive country, is making itself felt. The Geodetic Survey of the 30th Arc of Meridian runs through the territory and will naturally form the basis of any framework decided upon. Approximately half of the international and intercolonial boundaries have been demarcated; yet despite these surveys there is a lamentable lack of trigonometrical data. The topographical survey is in the same state.

The question of a major triangulation and a complete topographical survey is being held in abeyance for the present owing to the cost, but it is to be hoped that in the near future some allotment of money may be made so that this very necessary work may be put in hand.

At the present time the survey department is almost totally engaged on Farm surveys for the issue of final title to alienated lands and on such topographical surveys as could be carried out concurrently with the Farm surveys.

Trinidad and Tobago, 1923.

Governor	... ...	Brig.-Gen. Sir S. H. Wilson, K.C.M.G., K.B.E., C.B.
Crown Surveyor	...	Mr. John W. Macgillivray.

Staff.

Crown Surveyor.	6 Draughtsmen.
4 Assistant Surveyors.	1 Clerk and 2 pupil surveyors.

Expenditure.

The total expenditure of the Department during the year amounted to £5,807 of which £1,421 is accounted for under the heading of " Expenses of surveys ".

Traverses.

Forty-seven miles of traverse surveys were run between trigonometrical stations and 231 miles of boundary lines were surveyed and marked.

Topographical Survey.

The Topographical survey of Northern Trinidad and Tobago was organised independently under Captain G. Latham, R.E.

In Trinidad from July to December, 1923, 90 square miles were mapped, part of this area overlapping the map of the Trinidad Petroleum Development Company.

In Tobago, during the same period, the major and half the secondary triangulation were completed. The latitude and longitude were connected with a point in Trinidad, and observations were taken for azimuth and mean sea-level.

Cadastral Survey.

An area of 20,280 acres of Crown lands was surveyed by various oil companies in connection with oil mining leases, under the supervision of the survey department. These surveys have all been connected to the trigonometrical framework. Petition surveys of 100 lots of from 5 to 20 acres, special surveys of 175 lots and re-demarcation of boundaries have formed a large part of the year's field work.

Computing, Drawing, etc.

Besides the computing of the traverses run during the year, 1,263 plans have been made and 520 checked.

Maps.

A general map of Trinidad and Tobago, on the scale of seven miles to an inch, showing administrative divisions, has been printed locally. Thirty-eight Improved Sectional Maps (scale 1 : 9,504) have been published.

General Remarks.

The policy of co-operating with Oil Companies in the surveys done by them is continuing. As an example, the extensive cadastral survey of the Arenal–Piparo District executed by the Trinidad Leaseholds Limited has been connected to the trigonometrical framework and is to be incorporated in the sectional map concerned.

New Cadastral and Topographical Projection.

On consultation with the Geographical Section of the General Staff, it was decided to replace the system of curvilinear co-ordinates hitherto in use by a rectangular system. The area of the Island being relatively small, the Cassini projection was chosen and tables for the projection were computed in London.

Note on Maps and Plans.

Grant Plans.—The agricultural grants, in lots usually of 5 to 15 acres, with a few larger sugar estates, cover four-fifths of the Island of Trinidad. These are surveyed and plotted to large scale on Grant Plans.

Ward Maps.—Constructed on a scale of 1 in./12 chains, *i.e.*, 1/9,504, these unwieldy maps—one for each Ward—were in existence long before the Trigonometrical Survey was undertaken. They are now being abandoned.

Trigonometrical Sheets.—One hundred and twenty-three in number, each covering 3 minutes of latitude by 5 minutes of longitude, were prepared on the above scale, 1/9,504. On these are plotted the trigonometrical stations and all traverses which have been adjusted to the trigonometrical framework. It was the intention to cover them with control traverses, one mile apart, but this work was dropped in 1911.

Sectional Maps replace the Ward Maps. The control was traced from the "Trigonometrical" Sheet and the detail on the old Ward Map fitted in to this control.

Oil Maps, on the scale of 1/50,000, were reduced from the Trigonometrical Sheets by eidograph. They show all lands held under licence and lease by the Oil Companies.

For Smaller Scale Maps see the preceding Report of the Committee*.

A new and well-considered sheet series, based on the new grid, will shortly be put in hand.

* No. 1230 (1924) in the Colonial Annual Reports Series.

Uganda, 1923.

Governor	Sir G. F. Archer, K.C.M.G.
Director of Surveys, Land Officer and Commissioner of Mines	Mr. E. Richardson.
Deputy Director of Surveys and Acting Director of Surveys, etc.	Mr. Dyson Blair.
Assistant Director of Surveys...	Captain E. G. Fenning, D.S.O.
Assistant Land Officer ...	Mr. J. G. Strickland.
Conveyancer	Mr. D. L. G. Williams.

Additional Staff.

16 European Surveyors.
1 Office Superintendent.
2 European and 2 Indian Draughtsmen.
1 Computer.
4 European and 2 Goanese Clerks.
(This shows a reduction of one Surveyor.)

Trigonometrical Survey.

When the primary triangulation in Toro, based on the Arc of Meridian Survey, 1908, was joined on the east side with two sides of the Uganda Triangulation, the new triangulation was found to be 5 in. per mile on one side and 5·7 in. per mile on the other longer than that ascribed in the old triangulation.

On the south a close was made on Colonel Commandant Jack's Western Province Triangulation of 1909. The adjustment of this latter triangulation to the Arc is being undertaken, when a comparison will be obtained.

To link up the "floating" chain of triangulation in the Eastern Province, carried out in 1916–19, it is proposed to extend the Toro Triangulation to join this chain at the eastern end of Lake Kioja. The reconnaissance and beaconing has already been carried out and arrangements are being made to measure a check base line.

It is also proposed to run a second chain parallel to the southern boundary of the Protectorate, based on the Arc of Meridian and closing on the southern arm of the old Uganda Triangulation.

The following figures indicate the progress of triangulation during the year.

In Toro.—Nine main stations were occupied and 665 square miles covered, thus completing the main triangulation, the average triangular error of which is two seconds with a maximum of 4·91 seconds.

One hundred and eighty-six secondary minor and intersected points were fixed over an area of 400 square miles.

In Eastern Province.—Twenty-seven stations were fixed in breaking down the Eastern Province Triangulation, covering 350 square miles.

Topographical Survey.

Five hundred and ten square miles were surveyed in the Toro district.

Cadastral.

Four hundred and sixty-four square miles were surveyed in the Buganda district at an average cost of £14 8s. per square mile, making a total area surveyed of 8,333 square miles, or half of the complete area of the Kingdom of Buganda.

Four hundred square miles were also surveyed in detail in the Toro district, the work proceeding concurrently with the triangulation and topographical surveys.

Crown Land Surveys.

Thirty-five Ginneries and small plots, together with 55 estates covering a total area of 25,561 acres, were surveyed during the year.

Township Surveys.

Thirty-seven plots were laid out in Kampala and Fort Portal, while residential sites and a cemetery were demarcated at Mbale and the railway reservation at Port Bell.

Land Office.

Seven hundred and fifty-seven Final Certificates of ownership for native estates in Buganda were issued, covering 616 square miles.

The number of leases and grants of land, other than grants under the Uganda agreement of 1900, was 69.

Maps.

No new maps have been published, but the plotting and tracing of all field work is being kept up to date.

Expenditure and Revenue.

The total expenditure amounted to £24,601, while the revenue was £22,307 of which £17,273 was for Land Rents.

General Remarks.

There is one aspect of the map reproduction of this Department that calls for comment. It has been the practice of the Department to confine map production to those areas which it has surveyed itself. Consequently sheets have been published half of which are blank, although these blank portions are covered by G.S.G.S. sheets. The Masindi Port and Sekerr sheets are examples of this. Should it be required to study the latest maps of these areas, reference would have to be made to the Uganda Survey Department sheets and to the G.S.G.S. sheets of the same title. It is suggested that when such sheets are published they should be completed over the whole area by utilising such outside information as can be obtained.

There is little to suggest in amplification of the comprehensive Departmental Report. Some of the statistical details, such as rates of progress and cost, would be more clearly set out in the tabular form employed for other data. The report affords evidence of good progress on sound lines.

COLONIAL REPORTS—ANNUAL.

No. 1325.

REPORT

OF THE

COLONIAL SURVEY COMMITTEE,

1926.

(*For previous published Reports see No.* 828—*Cd.* 7622–19, *price* 2½*d.*, *No.* 1230, *price* 2*s.* 6*d.*, *and No.* 1286, *price* 1*s.* 0*d.*)

LONDON:
PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh;
York Street, Manchester; 1, St. Andrew's Crescent, Cardiff;
15, Donegall Square West, Belfast;
or through any Bookseller.

1927.

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No. 1325.

COLONIAL SURVEY COMMITTEE.
REPORT, 1926.

The period reviewed varies according to whether the reports received from the Dependencies concerned cover the year ending 31*st December*, 1924, *or* 31*st March*, 1925.

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

W. C. BOTTOMLEY.
E. M. JACK,
Colonel Commandant, D.G.O.S.
H. S. L. WINTERBOTHAM,
Colonel, General Staff.
H. P. DOUGLAS,
Captain, R.N., & Hydrographer of the Navy.

G. T. McCAW
P. LIESCHING } Secretaries.

December, 1926.

(2-) Wt. 15329/990 500 3/26 Harrow G.94

British Honduras, 1924–25.

Governor	...	...	Major J. A. Burdon, C.M.G.
Surveyor-General	...	...	Mr. F. W. Brunton.

Staff.

The staff has been reduced by one surveyor.

Revenue and Expenditure.

Expenditure.	£	Revenue.	£
Personal Emoluments ...	3,430	Royalties on Mahogany	5,335
Travelling Expenses ...	390	Other Royalties ...	145
Expenses of Surveys ...	310	Petty Licences ...	75
Instruments and Materials	70	Rent of Crown Lands	2,470
Collection of Rents ...	35	Sale „ „	780
Miscellaneous	60	Miscellaneous ...	135
		Royalties to Forest Department ...	1,240
Total Expenditure ...	£4,595	Total Revenue	£10,180

These figures represent a decrease of £505 in the expenditure and an increase of £1,320 in the revenue in comparison with last year.

Cadastral Survey.

Traverses were made of portions of the Stann, Plantation and Big Creeks and the Mullins, Sittee, Manatee, and Monkey rivers —total length, 11½ miles. Road and other traverses, totalling 37 miles, were run in the Belize, Stann Creek, Corozal and Toledo Districts.

Boundary Surveys.—The boundary of Belize, 2½ miles long, was surveyed for the new Property Tax Law. The boundary between Crown Lands and those of the Belize Estate and Produce Company was opened and demarcated, involving 12½ miles of traverse (included in the 37 miles above), and 17 miles of boundary line.

Allotments, etc.—Eighteen parcels of land, 494 acres in all, were measured in the Corozal, Stann Creek and Toledo Districts, and 60 town lots were laid out at Belize, St. George's Caye and Mullins River.

Levelling.

About 200 acres in the vicinity of Belize were levelled for an improvement scheme.

Plans and Applications.

About 160 plans and tracings were prepared for surveys and grants. Six hundred and seventy applications were considered, about 100 fiats granted, 50 leases cancelled and about 300 petty licences issued.

Trigonometrical Survey.

It is believed that this important work, which has been the subject of considerable discussion, has now been begun.

Ceylon, 1924–25.

Governor	**Sir W. H. Manning, G.C.M.G., K.B.E., C.B.**
Surveyor-General	**Mr. A. J. Wickwar, F.R.G.S.**
Deputy Surveyor-General ...	**Mr. A. H. G. Dawson.**
Assistant Surveyor-General ...	**Mr. C. R. Lundie, A.M.I.C.E.**
Superintendent of Observatory.	**Mr. A. J. Bamford, B.A.**

Staff.

Field—

12 Superintendents of Surveys.
40 Assistant Superintendents of Surveys.
2 Astronomers.
280 Grade Surveyors.
3 Junior Technical Assistants (Observatory).

Office—

4 Assistant Superintendents (Headquarters).
1 Superintendent of Process & Lithography.
1 Superintendent of Instruments.
1 Accountant.
420 Clerks and Draughtsmen.

Cost of Department.

No figures available.

Topography.

By the completion of 3,000 square miles of contouring, mainly in the Northern Province, the topographical revision, commenced in 1897, has been completed; the value of this achievement must not be minimised.

Though the topographical survey was recommended by Sir T. Holdich in 1897, apparently very little was executed until the visit of Major Hills in 1907. If the war years be included (11,500 square miles were contoured between 1916 and 1923), the average annual rate since 1907 has been 1,500 miles per annum, say 5½ square miles per working day. But this rate has been very variable, 8,200 square miles, say 30 square miles per working day, having been contoured during the year 1923–24. Since there is no information as to the number of topographers employed, the exact nature of their work and the cost rates, the figures above are of no value as a basis for comparative estimates.

Cartography.

The topography is being reproduced on the scale of 1 inch/1 mile. The contoured maps consist of a small-sheet series, of which 86 sheets are published out of a total of 270; and a new large-sheet series of 75 sheets in all, of which 31 are published. Thus, of the cartography about 35 per cent. has been completed. Some statement is obviously required as to the rate of progress of reproduction, present and anticipated, since the cartography is a long way behind the field work. It is not clear to the Committee that a policy has been adopted as to the periodic revision in the field and the issue of subsequent new editions of the sheets.

Triangulation.

The triangulation dates back to 1857, when the Negombo base, over 5 miles in length, was measured by General Gosset and Mr. J. Winzer. In 1859, a check base was measured by Mr. J. J. Grinlinton at Batticaloa, in length about 5½ miles. After adjustment of the intervening chain of 130 miles of triangulation, the former base reproduced itself on the latter to 1/13,270. A connection was also made at Delft Island on the north with the G.T.S. of India, the error of closure here being 1/13,450.

The triangular closures are indicated in the following table :—

Closures.	*Number of Triangles.*	*Percentage of Whole.*	*Average Error of Closure.*
" "			4″·2
0 to 3	24	44	Mean square error of observed angle (Ferrero's formula) ± 2″·95.
3 „ 6	15	28	
6 „ 9	11	20	
9 „ 12	4	8	
Total ...	54	100	

The adjustment of the triangulation, including the base equations, was made by a roughly approximate method, devised by Mr. A. E. Wackrill, who collected the observations and reduced them to order in 1893.

It is thus apparent that the trigonometrical survey of Ceylon is at best of a secondary order of accuracy.

Since the Waste Lands Ordinance of 1898, the additional triangulation has been mainly for Block Survey (see the Annual Report of the Colonial Survey Committee, 1908*); but the Holdich recommendation that the old triangulation should be improved and recomputed has never been carried into execution. It is the opinion of the Committee that any new attempt merely to patch up the old work would be a waste of labour.

Rectangular Co-ordinates.

These were computed as on a plane system, Pidurutalagala being taken as origin. The co-ordinates were calculated along circuits and the errors of the closures were distributed as in a traverse. As the Island lies within the longitudes 79° 40′ and 81° 50′, the error of treating the surface as a plane is not very great, though by no means inappreciable. Apparently, although Pidurutalagala is the origin, Knuckles marks the central meridian.

Spirit Levelling.

During the year 1924–25 the levelling of the 83 miles of line from Colombo to Puttalam was completed, with a probable error of ± one-sixth inch per mile. A line of 63 miles was run from Bibile to Chenkaladi with a probable error of less than ± one quarter-inch per mile.

It is intended to re-observe the 1909–14 level net. Fifty fundamental bench marks will be established at distances of 30 to 40 miles along the main lines. To this end, 11 fundamental, and a considerable number of intermediate, bench marks were constructed during the year under review.

Block and Settlement Surveys.

Block and settlement surveys covered areas of 260 and 310 square miles respectively.

Town Surveys.

In Colombo, 700 acres were contoured at 2-foot vertical intervals. Two thousand three hundred and sixty acres were surveyed in towns.

Application Surveys.

For areas of 50 acres and over there were 104 requisitions, the total number of questions involved being 3,560.

Wireless Work.

In connection with the Observatory the principal event of the year was the institution of a wireless time-signal service. The

* Cd. 3729–29.

signals are sent on Spark (600 metres) from the Welikada Station at 10 hours 27–30 minutes, a.m. and p.m., Ceylon standard time, and on Continuous Wave (2,300 metres) at 11 hours 27–30 minutes, a.m. and p.m. The transmission is timed to agreement with taps sent, second by second, in conformity with the International Code. The final group in each minute consists of three dashes, the third of which ends at the sixtieth second; the intermediate groups consist of a tuning series of X's during the first minute and, during the second and third minutes, two series of N's and G's, ending at each even 10 seconds except the sixties.

Meteorological Service.

This is continued as usual, in part co-operation with the Meteorological Department of India. Upper air work is also part of the normal programme.

Training School.

Training is maintained according to requirements.

Cyprus, 1924–25.

Governor	Sir Malcolm Stevenson, K.C.M.G.
Registrar-General and Ex Officio Director of Surveys...	Mr. B. T. Watts.
Assistant Director of Surveys...	Mr. P. E. L. Gethin.

Organization.

The Department is organized in three branches. Though the important Valuation and Registration Branches will receive only casual mention here, it is advisable to give the whole organization for purposes of comparative reference.

I. Survey Branch.—

Field Section.	2 Surveyors, 1st Grade. 2 Surveyors, 2nd Grade. 3 Assistant Surveyors. 12 Native Surveyors (temporary). 7 Permanent Land Registry Clerks. 56 Chainmen and Staffmen (temporary). 2 Pay Clerks (temporary).

Drawing Office.	1 Surveyor, 2nd Grade. 1 Native Surveyor (temporary). 19 Permanent Land Registry Clerks. 5 Temporary Clerks. 2 Chainmen.

II. Valuation Branch.—

12 Permanent Land Registry Clerks.
15 Temporary Clerks.
7 Government Valuers.
7 Popular Values (nominated by the Elected Members of the Legislative Council and not continuously employed).
1 Server of Notices.
1 Messenger.

III. Registration Branch.—

Registration Section.	8 Permanent Land Registry Clerks. 3 Temporary Clerks. 1 Collector of Fees (temporary).
Field Record Section.	11 Permanent Land Registry Clerks. 2 Temporary Clerks.

Expenditure.

	£
I. Survey Branch	11,991
II. Valuation Branch...	2,975
III. General Registration Branch	3,141
Total ...	£18,107

The cost of Administration, Stores and Pay-officers has been set proportionately against the three headings.

Survey Branch.

The organization is made elastic, to meet current needs. The report hereafter follows the order of the sub-sections.

Generally, the output of field work has been small compared with previous years, by reason of the precipitous nature of the country between the Machera and Adelphi forests and the extreme sub-division of some of the valleys into small holdings, necessitating chain survey and plotting on the scale of 1/1,250.

(*a*) *Trigonometrical Section.*—In the district of Papho, 285 fourth-order points, covering 122 square miles, were fixed and observed by one surveyor, working for four months. The cost was £162, i.e., £0·57 per point observed with a Troughton and Simms 6-inch micrometer theodolite. The positions and heights were computed at Headquarters.

(*b*) *Plane-Table* 1/5,000 *work* (*Nicosia*).—The Papho District party took up the survey of the western end of the Nicosia District, four surveyors covering 28,600 acres (5,760 acres of forest included) in the last four months of the year. The average size of cultivated plots was 1·7 acres, and of uncultivated plots 5 acres.

Another plane-table party of six working throughout the year covered 39,300 acres, including 2,875 acres of forest, in the rugged Adelphi-Machera country. The average size of cultivated plots was 0·87 acres, and of uncultivated plots 3½ acres.

The total cost of the work of both parties was £3,870, i.e., nearly 2*s*. per acre, or £63 per square mile.

(*c*) *Traverse and Survey of Villages* (*Nicosia*).—Thirty-nine villages were traversed in eighteen man-months by theodolite and chain, the chainage fixing 65 points per village and aggregating 7·4 miles per village. Forty-three villages, averaging 12 acres in area and 134 plots per village, were surveyed in 28 man-months at a scale of 1/1,250. The cost of the traverse and survey was £2,051, say £50 per village or £4 per acre or 7*s*. 6*d*. per plot.

(*d*) *Plane-Table* 1/5,000 *work* (*Papho*).—The area overrun in eight months by seven surveyors was 57,200 acres, including 17,260 acres of forest. The cost was £1,824, i.e., 7½*d*. per acre or £20 per square mile. The average size of cultivated plots was 1·8 acres; and of uncultivated plots 4·9 acres.

(*e*) *Traverse and Survey of Villages* (*Papho*).—The traversing of one village, in which 45 points were fixed, amounted to 7½ miles, executed by one surveyor in a fortnight. Twenty-six villages, averaging 21 acres in 140 plots, were measured up by one surveyor for a scale plan of 1/1,250. The cost of the traversing and survey was £510.

One thousand and thirteen points were fixed by theodolite traverse, which ran to 56 miles in all and was checked and completed in four months.

(*f*) *Traverse and Survey of Levka Village on the scale* 1/1,000.—The traversing and survey of this large Turkish village of 490 acres was completed in 9½ man-months at a cost of £347, i.e., 14*s*. per acre.

(*g*) *Topographical Survey.*—During the year, 453 plans on the scale of 1/5,000 have been reduced to the scale of 2 inches/1 mile. About 200 square miles have thus been completed, the

contours being obtained as follows. During the progress of the 1/5,000 plane-table survey, each surveyor by means of a locally-made clinometer observes the height of each point which he fixes. The result is that the heights of from 60 to 100 points per square mile are known, that is, 15 to 25 points per square inch on the scale 2 inch/1 mile. With a height control so dense as this, local knowledge and the aid given by the lines of cultivation, the contours can be drawn in with exceptional accuracy and with a minimum of additional expense, the work being done by one officer in his spare time.

(*h*) *Drawing, Plotting and Computing.*—

Record of Work.

Nature of work.	Clerks employed.	Scale of Plans.					
		1/500	1/1,000	1/1,250	1/2,500	1/5,000	1/31,680
Plans plotted by Co-ordinatograph ...	1	13	22	58	13	140	9
Area plotted, acres ...	3	130	731	1,719	422	—	—
Plans checked, No. ...	1	—	—	58	—	190	—
Areas computed, No.	3	—	—	—	120	52,675	—
Acreage computed ...	3	—	—	—	647	152,085	—
Fair Drawing, No. ...	4	—	4	52	4	157	—
Plans typed, No. ...	4	—	4	55	4	161	—
Plans examined, No.	1	—	—	68	4	186	—
Plans sunprinted, No.	1	(Various 735)		438	125	1,530	—
Sheets reproduced in Egypt. (Town of Limassol)	—	—	—	11	—	—	—

Valuation Branch.

Two valuers (official and popular) make from 60 to 70 valuations per working day :—say, Holdings in Land, 42; Holdings in Trees, 18; and Holdings in Buildings, 5. The valuation of the whole of the Larnaca, Famagusta and Limassol Districts has been completed, and a general district rate of taxation (Verghi Kimat) is in operation. In the Nicosia, Kyrenia and Papho Districts, valuation follows the heels of survey.

General Registration Branch.

Law XII of 1907 makes registration official and compulsory. It involves the preparation of Land Registers and the issue of title deeds. Thus, during the year 1924–25 30,974 title deeds were issued for 17,377 plots. Fourteen to fifteen title deeds are issued and plots registered by one registry clerk in a working day. The Registration Fees collected in the year amounted to £1,552.

Summary.

It is clear that a modern system of survey, valuation and registration, well co-ordinated, is in order of execution in this progressive community. All are proceeding apace, with incalculable advantage to the Colony.

Federated Malay States and Straits Settlements, 1924.

Governor of the Straits Settlements and High Commissioner for the Federated Malay States	Sir Laurence Nunns Guillemard, K.C.B.
Surveyor-General	Mr. V. A. Lowinger.
Assistant Surveyor-General, ...	Mr. C. J. Perkins.
Assistant Surveyor - General, Topography	Mr. J. N. Sheffield.

Comparative Return of Expenditure.

	Federated Malay States.		Straits Settlements.	
	$	$	$	$
Personal Emoluments	864,832		239,117	
Temporary Allowances	118,542		28,333	
		983,374		267,450
Clerical Services		31,782		7,746
Field Allowances	68,550		26,461	
Survey and Demarcation ...	171,767		73,002	
Instruments and Materials ...	29,627		7,209	
Contingencies	4,062		758	
Overhead and Miscellaneous ...	6,579		18,998	
		280,585		126,428
Special Expenditure (Malacca and Topographical)				118,804
		$		$
Total		1,295,741		520,428
Capital Account		246,893		—
Gross Expenditure		1,542,634		520,428
Expenditure less Revenue and Reimbursement ...		1,074,204		470,633
Ditto, 1923		1,206,030		434,716

Central Drawing Office.

The 4 inch/1 mile map of Singapore was published. Prepared by Malay, Chinese and Tamil draughtsmen under supervision, this is a fine map wherein the discrepancies are few and relatively unimportant. The standard 1 inch/1 mile sheets, 2N/10 and 2N/14, were in part completed. The general map of the States at 1 inch/6 miles was brought up to date.

Photo-Litho Branch.

There is an increasing demand from other Departments and from the public for printing of maps, plans, diagrams, etc. The number of maps and other documents printed was 258,543. The photographs taken by officers of the Royal Air Force attached to H.M.S. " Pegasus " were reduced to scale.

Instrument Making and Repairing Section.

The existence of this Section is stated to be justified by the indirect saving due to the prolongation of the life of instruments, and by the lower cost of instruments of a simple type constructed with the aid of a native staff. It has to be seen that they undertake no more than they can perform.

Trigonometrical Branch.

Little work was done during the year. The main triangulation in Trengganu was completed, 16 points being occupied and 16 additional points intersected. Some secondary trigonometrical controls for topographical work were established in north-western Pahang. Reconnaissance in southern Trengganu was carried up to Merchang.

Topographical Branch.

(1) The supervision of the native plane-tablers in the dense and very high jungle of the mountain axis, with peaks rising to between 6,000 and 7,000 feet in Perak and Pahang, demands much forethought and consideration if economy and technical success are to be secured and the health of the parties maintained. Sixty-nine points were cleared, 42 being fixed trigonometrically and 23 by plane-table. (2) In Johore, on the 1 inch/1 mile survey, the conditions were somewhat similar, the chief obstacle being resam fern, covering 30 per cent. of the country. For part of his time the supervisor was attached on liaison duty with the Royal Air Force. The control consisted of a number of points fixed trigonometrically and about 40 miles of special plane-table traverse. The plane-tablers generally ran 1,567 miles of traverse and fixed 12,836 heights by clinometer. The cost was greater than anticipated, the plane-tablers not having had sufficient training in small-scale work. (3) In the Penang Hills, for a map of 8½ square miles, on 10 inches/1 mile, 19 points were fixed trigonometrically while 8½ miles of traversing and 6½ miles of spirit-levelling were run. In all, the work involved 341 miles of plane-table traverse and 10,328 clinometric heights. (4) Of the Parit Forest Reserve in Perak, 14 out of the whole 37 square miles were completed. The control consisted of 17 theodolite locations, 25 miles of special traverse, 14 miles of spirit-levelling and 556 clinometric heights. The plane-tablers were chiefly engaged in running framework traverses between the

controls, involving 171 miles of line and 3,029 heights by clinometer. (5) For Town Plans, see the table following. (6) For a proposed hydro-electric scheme, 25 miles of traverse were run and 845 heights taken. Work plotted at 4 inches/1 mile was enlarged to 1inch/200 feet, with contours at 20 feet intervals. (7) Revision of some of the " 1 inch " sheets was partly done by probationers trained under European supervision. The following table condenses the details of much of the work described.

Topographical Branch—1924.

Situation, &c	Scale.	V.I.	Area.	Monthly Output per Plane-Tabler.	Cost.	Cost per Square Mile.
	1 to	Ft.	Sq. Miles.	Sq. Miles.		
Perak and Pahang ...	63,360	50	439	3·0	$ 89,034	$ 203
Johore	63,360	50	298	4·3	38,506	129
Penang Hills	6,336	20	8½	0·22	15,650	1,856
Perak Parit Forest Reserve	15,840	25	14	—	9,846	—
Selangor Kuala Lumpur T.P.	792	5	2·03	0·041	15,617	7,689
Selangor Kuala Lumpur Drainage.	792	5	0·11	—	734	—
Perak Ipoh Town Detail	1,584	—	2·10	0·183	6,422	3,507
Selangor M.S.V.R. Camp	6,336	20	2·5	0·407	1,786	714
Selangor H.E. Scheme ...	15,840	20	—	—	1,132	—
Perak K. Kangsar ...	63,360	50	97½	—	12,893	132

Revenue Surveys.

The following tables give some idea of the nature, extent and cost of the revenue work. Not all the activities in the various States can be tabulated. Thus, in Perak there were 968 redrafts of existing titles, street alignment surveys, the circuiting of unconnected lots, etc.; in Selangor cadastral maps were revised and plans prepared for the Public Works Department; in Negri Sembilan, marks defining the reserve for public roads were examined and positions verified, the revision of the Mukim registers was nearly completed, etc.; in Pahang, 83 miles of road survey, surveys of gaps in the railway reserve, of forest reserves, and of mining concessions were completed; for augmentation of output in Singapore, computers had to be borrowed; the Penang staff did much revision and re-survey together with general work in Wellesley Province and in Dindings; while in Malacca the chief work has been the Revisionary Survey.

State.	Total Expenditure.	Revenue.	Titles, &c., prepared.	Requisitions.		New Cadastral Sheets.			
				Satisfied.	Standing.	1 ch.	4 ch.	8 ch.	32 ch.
	$	$							
Perak	355,640	86,936	10,008	6,252	4,267	15	—	205	25
Selangor	173,055	44,600	?	6,901	3,682	—	—	1	—
Negri Sembilan ...	158,100	38,772	1,472	?	?	—	37	—	—
Pahang	193,255	25,939	4,327	1,723	2,884	—	—	94	28
Singapore ...	148,592	21,390	79	941	883	—	—	—	—
Penang	121,427	10,934	626	521	380	—	—	—	—
Malacca	224,077	17,471	381	448	5,555	—	—	—	—
Wellesley... ...	—	—	—	180	103	—	—	—	—
Dindings	—	—	—	487	399	—	—	—	—

	Lots.	Area.	Chainage.	Field Cost.	Cost per Chain.	Cost per Acre.		
						Mining.	Agricultural.	Small Holdings.
		Acres.	Chains.	$	Cents.	$	$	$
Perak	3,636	19,294	129,568	117,531	88	2·32	1·77	4·00
Selangor ...	1,438	13,497	20,560	—	95	3·33	0·96	2·06
Negri Sembilan	652	—	—	37,076	—	?	?	?
Pahang... ...	1,157	199,272	98,858	61,744	62	?	?	?
Singapore ...	1,637	—	53,366	56,255	92	?	?	?
Penang ...	—	—	—	—	103	?	?	?
Malacca (Thdl.)	3,218	74,080	143,968	65,280	45	?	?	?
Malacca (Compass)	12,288	19,159	147,916	28,200	19	?	?	?

It will be noted that, while in some States the statistical information is complete, in others it is rather fragmentary, so that an examination of comparative efficiency is not possible throughout.

Gold Coast, 1924-25.

Governor ... ... Brig.-Gen. Sir F. G. Guggisberg, K.C.M.G., D.S.O.

Surveyor-General ... Lt.-Col. R. H. Rowe, D.S.O., M.C.

Deputy Surveyor-General Mr. J. Clendinning, B.Sc.

Trigonometrical Survey.

The Framework Section concentrated chiefly on triangulation, the object being to run a chain across the Kibi range to the Obuasi range. The reconnaissance was completed and observations at eight stations were taken showing an average triangular error of 1·5 seconds. The first two figures have been rigorously adjusted. A base of 4½ miles was measured at Akuse.

Topographical Branch.

An area of 5,200 square miles was surveyed during the year —south of 7° 30′ N. on the scale 1/62,500, and north of 7° 30′N. on the scale of 1/125,000.

The boundary between the Colony and the Haute Volta from Sisili River to the Red Volta was re-determined and permanently marked by cement pillars, fixed by theodolite traverse.

Cadastral Branch.

The Town Surveys of Kumasi and Koforidua were completed.

Wireless Longitudes.

Pending the completion of the rigid framework of the Colony, experiments were made during the year with a view to providing a temporary astronomical framework. Wireless time-signals were used in determining longitude. The results show that the normal number of points that can be fixed by one party during the year is between 30 and 40, at a cost of about £80 per point. Comparisons were made between the longitude of Accra, Kumasi and Atebubu as obtained twenty years ago by telegraphic signals from Cape Town and carried forward from Accra by traverse for the latter two stations, and that obtained during the year by wireless signals. The results were as follows :—

	Accra.	*Kumasi.*	*Atebubu.*
	° ′ ″	° ′ ″	° ′ ″
Old Telegraphic Value ...	0 10 29·13	01 37 30·63	0 59 21·72
New Wireless Value ...	0 10 30·53	01 37 27·56	0 59 23·34
Difference : W.—G.T.	+1·40	−3·07	+1·62

Records and Reproduction.

Arrangements for the local reproduction of maps are now definitely complete, showing a saving of approximately £70 on an average sheet of the 1/125,000 series. Seven sheets of the Accra and two of the Kumasi Town Surveys were printed and plates were prepared for the new 1/500,000 road map. Minor reproduction included 1,024 sun-prints.

Details of Costs.

The estimate for the year amounted to £48,817, which includes the native School of Survey; while, in addition, £13,567 was spent on special topographical work, £7,903 on the special Colony Framework Section, and £1,260 on the survey of forest reserves. The total expenditure of the Department was therefore about £71,550.

The following details of the Koforidua Town Survey may be taken as typical of the cost of this class of work :—

		£	s.	d.
Plane-table work	approx.	252	0	0
Per trig. point	,,	8	0	0
Per traverse mile	,,	16	0	0
Levels per mile	,,	5	10	0
Detail	,,	1	0	0
Examination	,,		10	0
Total Cost ...	£1,802			

Remarks.

Rapid improvement has been made in the determination of time for wireless longitude. The start made on the new trigonometrical framework has been clearly successful. In other respects the methods of the Department appear thoroughly sound. By its forethought, its orderly progress, and its enlightened policy, both technical and administrative, it will certainly do much for the development of the Colony.

Hong Kong, 1924.

Governor ... ... Sir R. E. Stubbs, K.C.M.G.
Director of Public Works ... Mr. H. T. Creasy.
Superintendent of Crown Lands ... ... Mr. L. C. Parker Rees.

Staff.

The staff is the same as the previous year except as regards the native surveyors; there are now six Chinese Assistant Surveyors and fourteen Chinese Apprentice Surveyors as against three and seven respectively.

Cost (exclusive of office accommodation):—

	$
Salaries	167,784
Coolies' Wages	11,543
Conveyance Allowances	9,440
Rent Allowances	7,557
Survey Expenses, Coolies' rents, etc. ...	12,163
Total for 1924 ...	$208,487
,, ,, 1923 ...	$153,002

The cost of the Department is increasing steadily, being nearly thrice that of 1914 and more than twice that of 1920, while the number of European surveyors has grown from eleven to sixteen since 1914.

Duties.—The lands branch of the Public Works Department is responsible for all surveys, except those undertaken by the military authorities; it submits reports on all applications for land, conducts all sales of areas to be let on long leases, and issues certain permits and licences; it keeps records, is responsible for the preparation of lease plans of all grants, and controls four bailiffs whose time is occupied in preventing squatting and encroachment on Crown Lands. One principal Land Surveyor has charge of survey work and land administration in Hong Kong, another in Kowloon and the New Territories.

Trigonometrical Survey.

New stations have been erected on Tai Mo Shan and Tsing Islands and those at Kai Keung Leung and Tai Lam Chung have been rebuilt, while those at Turret Rock and Cheng Shui Tan have been repaired. The field work was almost completed. A new station was erected at Mount Senhouse, Lama Island, and minor stations fixed in course of the work of a Colonial Survey Section have been or will be permanently marked and co-ordinated with the Colony system.

During the course of a military survey it became evident that the triangulation of Hong Kong and the Leased Territories is neither very precise nor perhaps adequately marked. This state of things must cause extra work and add unnecessary labour. On the completion of the new topograpical survey it may be possible to give some help to the Land Survey Department in detecting shaky points. It is, however, probable that the most economical procedure would be to measure a new base, re-observe and re-mark. It should be specially noted that the Land Survey Department did everything that was within their power to assist the field work of the new survey.

Air Photography.

The air photography executed by Royal Air Force officers attached to H.M.S. " Pegasus " necessitated the preliminary fixing of numerous ground controls, in which the Survey Office participated. All possible assistance was given to facilitate this work. As a development thereof, a reconnaissance of Lantao Island was to be carried out in October.

Topographical Survey.

Five hundred acres in four areas were surveyed, contoured and plotted on large scales.

Cadastral Survey.

A traverse of 15 miles was run and checked between Castle Peak and Lai Chi Kok, and permanent marks established. Over 500 acres in six lots were surveyed and plotted. Surveys of 32 lots for sale were made in various centres; these lots, aggregating less than 15 acres, will bring in an annual rent to the Crown of $3,000, i.e., about $1 per 200 square feet, or $21 per acre, while the sale realised $28,600 per acre. Two hundred and eighty-four building areas were set out, and an area of 82 acres defined on the slopes of Jardine's Look-out. Recommendations, schedules and plans were prepared for numerous development lots at Wongneichong and for 700 lots in Kowloon and New Kowloon not conforming to the Town Planning Scheme.

Ordnance Surveys.

The total area surveyed and plotted during the year was 587 acres. The survey of the Western District and the City was continued and part of the City boundary on the southern side was defined, boundary stones being set up at suitable points. This work was carried out in conjunction with the training of seventeen Chinese Student Surveyors.

Jamaica, 1924.

Governor	... ...	**Brig.-Gen. Sir S. H. Wilson, K.C.M.G., K.B.E., C.B.**
Surveyor-General	...	**Mr. W. Anthony Baker.**

Staff.

The staff remains the same as last year, being under strength to the extent of one Surveyor. The Assistant Surveyor-General has been incapacitated by illness.

Expenditure—	£
Personal emoluments	4,224
Other charges	1,876
	£6,100

Revenue—	£
Land Sales, etc.	6,299
Sale of sleepers, shingles, etc.	341
	£6,640

Surveys.

Two surveyors only have been available for the field for a period of three months in all. Licensed surveyors have been employed in certain cases for fixing the boundaries of Crown Lands and for small allotments. It is presumed that the expenditure of £630 under "other charges" in part covers the fees paid for this work. The field work consisted mainly of closed traverses with errors of from 1 in 300 to 1 in 8,600. It may be remarked that no work by a Government department should show an error as great as 1 in 300. The traverses aggregated 79 miles, and were run at a daily rate of 51 chains and at an average cost of £9 17*s*. 6*d*. per mile.

Lands Branch.

The work of this branch continues to grow. The arrears of work in connection with forfeiture are being diminished. Between 1921 and 1924, 1,024 defaulting tax-payers have been induced to rescue their holdings, totalling 4,600 acres. Against an expenditure of £600, the revenue has collected arrears of taxes amounting to £2,500, and £500 has been received from costs of forfeiture. Interlocutory judgments have been obtained in 101 cases, involving 8,558 acres; and 1,424 holdings, containing 5,437 acres liable to forfeiture, are in course of receiving attention.

During the year, 84 per cent. of the plans submitted for registration of title have been handed back to licensed surveyors, whose work is growing so steadily worse as to render action inevitable.

Crown Lands.

The administration of Crown Lands involves the oversight by bailiffs and headmen of numerous predial tenancies, which continue to give much trouble. Spring Garden Estate was parcelled and sold in 235 lots covering 714 acres. A protracted drought, followed by heavy rains, injured crops generally, so that in some cases the purchasers of land by instalment were in arrears with their remittances.

Nigeria, 1924–25.

Governor	**Sir Hugh Clifford, G.C.M.G.**
Surveyor-General ...	**Mr. A. Cleminson.**
Deputy Surveyor-General	**Capt. T. J. Waters.**

Staff.

2 Assistant Surveyors-General.
9 Senior Surveyors.
12 Surveyors.
2 Surveyors (Topographical).
3 Surveyors (Minesfield).
1 Accountant.
1 Lithographer.
1 Surveyor.
4 Surveyors (Trigonometrical).
1 Draughtsman.
48 Native Surveyors.
1 Chief Draughtsman (Grade I).
2 Chief Draughtsmen (Grade II).
38 Draughtsmen.
2 Clerks H.D. (Grades I and II).
6 Clerks H.D. (Grade II).
22 Clerks L.D.
1 Lithographer and Instrument Repairer.
78 Native pupils and learners.

Expenditure.

	£	£
Personal Emoluments		35,758
Other charges—Chainmen and Labourers ...	7,905	
Passages	2,164	
Transport and Travelling ...	4,378	
Instruments and Stores ...	3,382	
Map Publication	370	
Miscellaneous	659	
	——	18,859
Total		£54,617

Revenue.

The revenue earned by the Department was approximately £10,000. It is estimated roughly that the increase of revenue directly attributable to surveys of farm areas in the Kano region is £35 per annum per square mile. The cost of such a survey is about £25 per square mile, or 9½*d.* per acre.

Trigonometrical Section.

This is composed of two groups, of which the first contains two Senior Surveyors and one Surveyor and the second of one Senior Surveyor and one Surveyor. Four Native Surveyors are attached. The year's work contemplated the connection of the Naraguta and Udi Bases. The first group worked in easy country; but such hills as do rise between Onitsha and the Udi Base are for the most part heavily timbered. The difficulties

were finally overcome with considerable success by the second group. For work in such country it is obvious that special attention must be concentrated on the reconnaissance. Moreover, during the Harmattan, heliographs may be seen afar if means of directing the light beam are set up either in advance or, when rough heights and positions are known, with instrumental aid after the haze has obscured the distant landscape.

The first group fixed 48 stations and observed eight intersected points in an area of 5,370 square miles and, in addition, beaconed 27 stations in an area of 2,280 square miles. The average error of closure of 55 measured triangles was 2″·6, giving a probable error of observed angle of ± 1″·2. The ten polygons have been adjusted by a method nearly rigorous. The second group in the difficult country in the south occupied 28 stations, observed 12 intersected points and one azimuth, and covered 800 square miles of country. The four polygons were adjusted; they involve 36 triangles with a mean error of closure of 2″·5, and a probable error of observed angle equal to ± 0″·85. The computations were made at the Lagos Headquarters. Under the difficult conditions encountered by the southern group, the progress of both groups was good. The costs were as follows :—

Reconnaissance and Beaconing, 2·4*s*. per square mile for 4,800 square miles.

Observation, 14·1*s*. per square mile for 6,170 square miles.

The total cost of the work was £4,914, equivalent to 15·9*s*. per square mile. This excludes stores (£260), passages and leave pay.

Topographical Section.

The topography made poor progress during the year. The employment of junior African surveyors was unsuccessful, and two European probationary surveyors who arrived in the Colony later, though keen, were too inexperienced to get quickly into working form. Moreover, there were discrepancies in the old controls, and, finally, the Okigwi-Udi-Onitsha country was so unsuitable for plane-tabling that it was necessary to have recourse to the theodolite and compass traverse. The uncompleted Field Sheets Nos. 213, 214, 215 and 216 of the scale of 1/62,500 were finished. From December to 31st March the following was the record of work :—

			Cost.
Theodolite Traverse	...	245 miles	£1 7 3 per mile.
Compass Traverse	...	2,160 ,,	
Rope and Sound	...	40 ,,	
Planimetry and Contoured Relief...	...	1,073 sq. miles	£1 18 7 per sq. mile.
Planimetry alone	...	390 ,,	

Cost of Trigonometrical and Topographical Work.

The cost of the trigonometrical survey (£4,914) included £1,626 borrowed from the cadastral side. The amounts chargeable against the estimates are therefore :—Trigonometrical, £3,288; Topographical, £1,651; Stores, £245; Total. £5,184.

Cadastral Branch.

In the Southern Provinces since 1922 a Senior Surveyor has controlled the work of the Lagos, Benin, Aba and Ibadan sections. In the Northern Provinces, the Assistant Surveyor-General at Kaduna is responsible for all work except trigonometrical and topographical.

(a) *Southern Provinces.*—The cadastral branch here controls all surveys in Lagos and environs, together with the decentralised sections at Aba, Warri and in the Eastern Provinces, and also Ibadan in the Western Provinces. The high value of land in the Southern Provinces, and the multiplicity of Crown Grants, dating from 1864 onwards, render the lack of a ruling framework in Lagos and Ebute-Metta generally a serious defect. A systematic investigation of Titles and Crown Grants in Lagos and Ebute-Metta will have to be undertaken as soon as it is economically expedient. The branch deals with surveys of concessions, towns, government stations, native quarters, local boundaries, forest reserves, trade and mission sites, and the like.

(*b*) *Northern Provinces.*—Here the organization is as follows :—(1) Minesfield Survey; (2) Kano Revenue Survey (Departmental Title); (3) Township and Leasehold Surveys; (4) Special work.

(1) *Minesfield Survey.*—This section deals with the fixing of the boundaries and assignment of the areas of all mining concessions granted under Mining Lease or Exclusive Prospecting Licence, together with the allocation of Mining Rights, Water Leases and Certificates of Occupancy in the tin industry. Nine surveyors traversed 790 miles, surveyed 18,500 acres for 129 mining leases, and 225 square miles for 57 exclusive prospecting leases; the fees received amounted to £6,591.

(2) *Kano Revenue Survey.*—The Administration of the Northern Provinces requires the survey of districts and farms for taxation. The Kano Section surveyed 92 square miles during the year, increasing the aggregate square mileage to 368. The native staff totals 129, including 41 attached to the Government, 69 to the Kano Native Administration, 10 at Katsina, and small groups at Sokoto, Ilorin and Zaria. The Assistant Director reports that illness among the native staff accounts for ten days per annum per head.

The Kano section has trained also a topographical class which contoured a 3-minute square at Fanisan for military purposes, and a catchment area at Goron Dutsi for the Kano water supply; the latter has required accurate levelling and a large-scale plan. Plans and sections were also prepared for a water scheme at Kazaure. Main traverses approximating to 100 miles have been run north of Kano and marked with concrete beacons.

The lithography of the Nigerian Survey is concentrated at Kano, the climate being more suitable. The plant was increased by a rotary press, a ruling machine, a stitching machine, and two oil engines. Two million printing impressions were drawn during the year.

(3) *Township and Leasehold Surveys.*—Road surveys and levelling, with plans, have been executed for the Kano Town Planning Board. Road surveys were also carried out in Gumel Emirate. Leaseholds for merchants and others are demarcated by this sub-section.

(4) *Special Work.*—The only special work during the year was that of the Sokoto Irrigation Scheme. The output of this sub-section was 39 miles of theodolite traverse, many miles of compass traverse (unlevelled), 7,000 acres contoured at 1-foot vertical interval and plotted on eight sheets to the scale of 1/5,000.

It is to be remarked that it is by no means easy to assign the various branches of work to their correct headings, the reports being too diffuse. The reports should be drawn up to follow strictly the lines of organization, which itself seems to lack definite bounds between the sub-sections (2) and (3) above.

Maps.

A general map of Nigeria in 16 sheets, on the scale 1/500,000, was printed by the Ordnance Survey. An office map, on the scale 1/M, was produced by Messrs. Stanford & Co., and is also in general demand. Further, a map of the Colony and Protectorate of Nigeria on the scale of 1/2M was printed by Messrs. Stanford & Co. in colours, and forms the clearest geographical map of the Colony which has yet appeared. Traffic maps are a new feature, likely to develop.

Health.

The Surveyor-General has unfortunately to report the death from blackwater fever of Mr. S. Boulderson (Kaduna, 16th June, 1924), and of Mr. R. L. Drowyn, Senior Surveyor, who had just retired.

General.

The reports afford evidence that the efforts of Nigeria to place the survey, disorganised during the war, on a sound footing are already meeting with success, though much yet remains to be done.

Northern Rhodesia, 1924–25.

Governor	Sir H. J. Stanley, K.C.M.G.
Director of Surveys	Mr. W. G. Fairweather, B.Sc.
Examiner of Diagrams and Surveys	Mr. L. W. G. Eccles, M.C.

Staff.

The staff includes five Assistant Surveyors, one Native Clerk, and six Native Chainboys; but the year's estimates provide for three additional Assistant Surveyors. Of the present staff three are normally at Headquarters, three in the field, and one on leave. Occasional assistance is obtained from a few licensed surveyors, whose work is limited to sub-division of land held under Title Deed and to original surveys of land grants in special circumstances.

Cost.

	£	£
Personal Emoluments—		
Staff Salaries	4,180	
Additional Staff	525	
Natives and Allowances	273	
		4,978
Other Charges—		
Field Expenses	1,720	
Travelling, Uniforms and Rations ...	438	
Instruments	150	
Office Expenses...	150	
Outfit Allowances	60	
Meteorological	150	
		2,668
Total		£7,646

Trigonometrical Survey.

There are scattered patches of good secondary triangulation in the occupied areas. During the coming year it is hoped to connect some of these by a secondary chain with the Arc of Meridian; this chain will run from the Arc to the railway, probably from Feira to Chilanga.

Topographical Survey.

Though topography has been carried out along some of the boundaries, and by Mr. Croad, Mr. Thompson and others, there is no general topographical survey. It is hoped to make a commencement this year in the region of the secondary chain mentioned above.

Special Work.

Consequent on the report of a Native Reserves Commission, the proposed Native Reserves within the North Charterland Concession have been provisionally demarcated by prismatic compass and cyclometer, controlled by observations of latitude and azimuth. A number of compass traverses have been run along roads owing to the growing demand for road transport. Mile posts were erected along part of the Katombora road from Livingstone.

Useful traversing has been done by the Rhodesia Minerals Concession, Ltd., in the Chilanga and Feira sub-districts, the area covered being 120 by 50 miles. The work will prove valuable as auxiliary framework for the topography proposed above. A copper-mining company laid out a new township at Bwana Mkubwa.

Maps Prepared.

The 1/M Wallace-Beringer map of North-Eastern Rhodesia has been extended over North-Western Rhodesia and revised, and is now issued in black only : it is the only general map of the Colony alone. Forty-four of the forty-eight sheets of the 4/M series have been compiled in so far as the material available permitted and have been put on sale. Plans of farms, either singly or in groups, are in general on a scale of 1/50,000. The Township Plans of Livingstone, Broken Hill, and Lusaka are being re-drawn on the scale 1/1,200. In the absence of a general trigonometrical framework, the time is not yet ripe for the production of a large-scale series.

Cadastral Work.

Tapes are standardised on a 100-foot base at Livingstone. In the triangulation of group surveys the largest allowable error of closure is 10 seconds; the closure usually averages from three to seven seconds.

The statistics of work done are ample and are kept up to date. The statistics of cost per unit of area are doubtless very variable in the present state of development. The following are the principal divisional areas of the Territory :—

	Square Miles.
North Charterland Exploration Company's Concession	10,000
British South Africa Company's Freehold Areas	4,310
Crown Land—Grants with Final Title or Option of Purchase	4,386
Crown Land—Lease without Option of Purchase	28
Crown Land—Residual Area, including Native Reserves	269,226
Total Area of Colony	287,950

In the following table the cadastral work of the year is summarised.

	No.	Acres.	Purchase Price. £	Survey Fees. £	Quit Rents. £	Annual Rents. £
Title Deeds to Farms issued ...	20	56,036	5,784	1,016	56	—
Title Deeds to Plots issued ...	20	22	1,490	85	—	—
Permits of Occupation issued...	22	43,733	9,655	858	—	492
Permits of Occupation cancelled	22	61,294	—	—	—	468
Leases issued—						
With Option of Purchase ...	8	415	1,200	—	—	471
Without Option of Purchase	15	4,974	—	—	—	245
Cancelled	5	992	—	—	—	24
Building plots alienated—awaiting Final Title	25	32	1,845	103	—	—
Farms surveyed	34	83,333	—	1,832	—	—
Plots surveyed	78	69	—	157	—	—
Soldier Settlement Titles ...	5	13,118	—	255	13	—
Railway Farms—						
Titles issued	2	1,347	—	51	1	—
Farms surveyed	7	9,719	—	253	10	—
Gross Totals	263	275,086*	19,974	4,610	80	1,698*
Totals less Cancellations ...	236	212,800	—	—	80	1,206

* The detailed figures are given to the nearest acre or £1 sterling.

The Department has undertaken miscellaneous duties, such as the training of probationers and others and the keeping of meteorological records. Its field work has lain between Livingstone and the bend of the Kafue on the west, and Fort Jameson on the east, and its general output has been considerable. Survey fees make a large offset against the annual expenditure.

Nyasaland Protectorate, 1924–25.

Governor ... ... Sir C. C. Bowring, K.C.M.G., K.B.E.

Lands Officer ... ... Mr. J. E. Alexander.

Staff.

The staff consists of the Lands Officer, three Assistant Surveyors (two on contract), one Draughtsman, one European clerk, two native tracers and three native clerks.

Cost of Department.

	£
Personal Emoluments	3,279
Passages and Travelling Expenses	468
Miscellaneous	62
Total ...	£3,809

Trigonometrical and Topographical Survey.

None.

Cartography.

None.

Cadastral Survey.

The work of the staff during the year was confined to 43 blocks of land, aggregating 16,400 acres, leased from the Crown in different parts of the Protectorate. No particulars are given as to methods and nature of survey; and there is no evidence whether this work is controlled and tied to any ruling framework. A number of traverses have been run in the Colony from time to time, to which these surveys may possibly be tied.

In view of the slow development, surveys are relatively expensive; these apparently uncontrolled surveys cost about 4*s*. 8*d*. per acre. The cost, though not excessive, is no doubt largely dependent on the time consumed in travelling to isolated districts. The report is, however, too condensed to permit of a proper appreciation of the difficulties, or of any recommendations of a helpful nature.

Sudan, 1924–25.

Governor	Sir G. F. Archer, K.C.M.G.
Director of Surveys	Mr. A. A. R. Boyce, F.R.A.S.

Staff.

The only changes since the preceding year were due to the appointment of an Inspector of Surveys, Grade III, and to the retirement of a draughtsman.

Expenditure.

	£	£
Personal Emoluments I	20,694	
,, ,, II	1,410	
		22,104
Other charges :—		
Transport	2,704	
Upkeep of Motors	250	
Travelling, Forage and Climate Allowances	1,345	
Guides and Labourers	1,300	
Gezira Beacons	201	
Purchase and Rent of Stores ...	442	
Stationery and Printing	850	
Office expenses	96	
Postal and Telephones	156	
Contingencies	100	
		7,444
Total (1924) ...	£29,548	
,, (1923) ...	£27,162	

Triangulation.

The Egyptian Irrigation Department carried out a triangulation over, and mapped, a large area between Lake Tana and the eastern border of the Sudan. A Sudanese Native Surveyor, attached to the Nile-Congo Divide Company for a period of nine months, covered with triangulation an area of 2,750 square miles in the southern Bahr-el-Ghazal and made a detail survey of 80 miles of the River Ibba.

Topography.

In connection with the mapping of the more distant regions of the Sudan, wireless time-signals are being utilised with advantage. The experience of Lieutenant-Colonel King in the more remote country of Jubaland proves that European signals may be picked up without difficulty, provided that the apparatus is specially designed for the work. The Sudan, therefore, is not compelled to fall back on secondary stations like Massawa and Mogadishu, from which the position of Wau was fixed. The report does not state if the signals at the two Italian stations were accepted as giving true East African time, or whether the signals were simultaneously received at another point of known longitude in the Sudan. In any case it is obviously of importance to compare directly with the fundamental longitude of Greenwich, as is now clearly possible.

It is hoped in this way to obtain something of the nature of accurate maps of the Bahr-el-Ghazel and Mongalla provinces, where triangulation or traverse would be laborious, expensive and slow. A great extension of the principle of fixing latitudes and longitudes astronomically would be of immense assistance to the compilation of first and provisional editions.

The nature of the cadastral work in the irrigation areas is such that accurate contouring is needful. This will be treated under *Contouring and Levelling.*

The Khor Arbat Delta, covering 65,000 feddans (1 feddan = 1·04 acre), that is, about 105 square miles, was surveyed topographically and a wheel and compass traverse was made of about eighty miles of the boundary between Fung and Kassala Provinces in the vicinity of Mafaza. A considerable length of the Khor el Atshan was also surveyed.

Route Sketches.

The detail on the topographical maps in the outlying regions depend almost entirely on route sketching, executed by officers in the course of their travelling on administrative or other duties. A valuable set of such sketches, with plane-tabling, was forwarded by Lieutenant-Colonel C. R. K. Bacon; they cover nearly the whole of the Pibor District. The Director reports a distinct increase both in the number and quality of these reports. The route surveys are plotted on the 4/M series of maps. It is not to be expected that the full benefit can be got from such sketching until officers are supplied with enough " positions " to allow of proper placing and orientation.

Contouring and Levelling.

The principal work of this nature during the year arose from the taking over of the contour survey of the Gezira, the large area in the fork of the White and Blue Niles. Up to the middle of January contour levellers were required to run 6-minute sides (10·4 kilometres) per working day. The total area levelled during the year was 396,580 feddans, i.e., 645 square miles. The mean closing error on 12-mile circuits varied, according to the season, from 1·5 to 4 millimetres per mile. The contour levellers, on the other hand, were given a tolerance of 10 millimetres per mile, plus the closing error of the control circuit.

The manner of breaking down the control net into the contour net is not quite clear. " Control levels are 200 metres apart." The meridional distance between " spot levels " is 600 metres and the longitudinal distance 300 metres. The cost of the contour levelling is about 6 milliems (1½*d.*) per feddan. The field sheets were prepared on a scale of 1/20,000.

Trouble has arisen in the Gezira from the screw-piles used by the Egyptian Survey Department as B.Ms. on their lines of precise levelling in the Nile Valley; the piles at Abu Ushar and El Furabi had apparently moved 5 centimetres. Accordingly a mean of ten such B.Ms. was taken as Datum. In the Director's opinion the best plan is to set up B.Ms. in groups of 3 screw-piles, separated by reasonable intervals; the interval would, no doubt, depend on the nature of the site.

A portion of the Sennar Dam contour line was surveyed and plotted on the maps of 1/4,000 scale.

Township Surveys.

A detailed survey of the town and environments of Wau has been made at the request of the Governor; plans covering an area of 21,000 feddans are now in course of preparation at Headquarters.

This work is increasing in volume. At Omdurman, the surveys for alignments, sub-divisions and sales numbered 2,750. In Khartoum and Hillet Hamad 500 alignments were made. Alignment was also executed in Kosti Suk and Hillet Fellata. The alignment survey of Hillet Kojali is in progress; Shendi and Shereik Suk, with the plans, have been completed. Quarters and numerous building plots were laid out in Wad Medani.

The surveys of El Dueim, where an office has been opened, of Kassala and of Gebeit have been completed and the alignment and registration of El Dueim is proceeding. Maintenance involved work in Suakin, Tokar, Sinkat, Tendelti, Jebelein, Kosti and Halfa. Maintenance and alignment have been carried out in Hassa Heissa, Rufaa, Kamlin and Wad-el-Haddad.

Cadastral.

Though the contour levelling and township surveys are properly cadastral, it has been convenient to treat them separately. On the Blue Nile the most important work lay in the Gezira Canalisation Area. Lists of areas of plots in the 1924 Rented Area and Extension, 137,096 feddans in all, were supplied to the Commissioner of the Gezira. A length of 500 kilometres of canals was surveyed and plotted. The Gezira beacon-repairing parties covered 1,325 square miles, renewing 1,444 beacons. The boundary between Dueim and Geteina Merakiz was run for 53 kilometres. Two small re-afforestation areas were demarcated. There were surveyed also the compensation areas for Kawa Aerodrome and 1,575 feddans in Um Rob and Abu Gow. In Khartoum Province, sub-divisions and new plots have been set out in various localities, and all the " Haddam " (land washed away by the high Nile) has been measured up. A survey of 32,000 feddans was made for the Kassala Cotton Company, 120 miles of line being cleared, chained and surveyed, and 205 permanent beacons erected.

Cadastral Computing and Compiling.

The calculation of areas forms an important branch of work. Nineteen thousand plots in the Manajil Settlement, varying in extent from 3 to 300 feddans, and aggregating 542,000 feddans, were computed. The 377·2 contour of the Jebel Aulia Dam surround was plotted from the Egyptian maps; this work extends 180 miles from Jebel Aulia to Jebelein.

Printing and Reproduction.

A new printing press was shortly to be in working order; with this it is hoped to do all ordinary map production in Khartoum.

The Department has introduced from Egypt the Hall gum-bichromate process for reproduction, whereby maps drawn on tracing cloth are sun-printed upon sensitised zinc plates; trouble from the chemicals was overcome by altering their proportion. The total number of sheets issued in 1924 was 11,000, as against 5,090 in 1923. Zinc plates in stock now number 310.

Maps.

The Headquarters topographical staff has been fully employed in compiling the maps of the new boundary between the Sudan and French Equatorial Africa; nineteen frontier sheets of the 4/M map have thus been revised. Three new sheets in the Mongalla Province have also been completed. One of the 1/M sheets of the Western Sudan was nearing completion. A small-scale general map of the White Nile Province, on the scale of 1/2,000,000, was compiled. Thirty-two special maps were drawn for reproduction, including Port Sudan Harbour Extension, Gash River and tributaries, and various military maps.

Twenty-six sheets of the Gezira 1/20,000 contoured map and other miscellaneous maps have been transferred to zinc by the gum-bichromate process. Three sheets on the scale 1/50,000, showing the Gezira Canalisation Scheme, were made ready for reproduction. Twenty-nine Key Maps of Sections, showing the individual plots of the Manajil Settlement, have been compiled on the scale 1/20,000 from the original 1/4,000 plans. One hundred and thirty-eight tracings of these Key Maps, covering an area of 75,000 feddans, were prepared for sun-printing and issued to the officials concerned. Maps on the scale of 1/50,000, showing all Government and privately-owned land below the 377·2 contour at Jebel Aulia, were completed. A plan of the Mikailab pumping area and various small plans were supplied to several Departments. Plans of Kassala township on the scales of 1/500 and 1/2,500 were drawn.

Miscellaneous.

A survey, with levels, of the pipe track from Khor Arbat was plotted and a plan supplied to the Public Works Department.

General.

Out of twenty-six Effendis who sat at a qualifying examination for Junior Surveyors, only eight passed. The Director is preparing an elementary textbook for issue in English and Arabic. It will be seen that the Department carries on work of an exceptionally varied nature.

Trinidad and Tobago, 1924.

Triangulation.

During the civil year covered by the present report, sixteen new stations were fixed, for which purpose twenty stations were occupied. Average angular closure = 4·4 seconds. Two elevated signals, 50 feet high, and heavy clearing, were necessary.

Topographical Survey.

The Topographical Survey of Northern Trinidad and Tobago was continued by the party organised independently under Captain G. Latham, R.E.

From January to June the season was very dry, and in Trinidad 300 square miles were mapped, and all work was finished north of a line from San Fernando to Rio Claro, maps of the oil companies being incorporated. From July to December, 250 square miles were mapped, the season being very wet.

In Tobago steady progress was made throughout the year. All observing work was completed over a network of trigonometrical stations at two miles interval. The accuracy is sufficient for cadastral work. Many artificial features, such as churches and chimneys were intersected, especially on lines of communication.

An examination was made of Messrs. Pearson's map. The detail was found to be excellent, but the heights irregular, being good near the railway, but with errors up to 130 feet on the central range.

Petition Surveys.

The work done is shown in the following table :—

Town and Village Lots.	Parcels of Land totalling 300.			
	Under 5 acres.	5 to 10 acres.	10 to 20 acres.	Over 20 acres.
133	131	118	42	9

Concession Surveys.

The total area of Crown Lands measured by contract surveyors, under departmental supervision, was 16,640 acres. These surveys of oil and other concessions have been connected to the trigonometrical framework and the records filed in the Department.

On the Oropuche Drainage Scheme, 586 chains of boundary lines were run by the staff to complete the survey of these Crown Lands, which comprise 3,613 acres in six parcels.

Re-surveys, Reserves, Resumptions for Roads, etc.

Under this heading the traverses totalled 434 chains; but by reason of the absence of proper records and the imperfections of the old surveys, this work absorbs much time and labour.

Control Surveys.

Traverses, in total length 56½ miles, were run between trigonometrical stations to control the surveys of alienated lands. The following table shows the division of these surveys between the staff and contracting surveyors.

	Petitions.		Concessions.		Reserves, Resumptions, &c.		Controls.
	chains.	acres.	chains.	acres.	chains.	acres.	chains.
Staff ...	10,532	988	722	3,613	150	12	3,893
Contract ...	5,062	999	4,234	16,640	284	5	632

Maps and Plans.

Twenty-six sectional maps were issued during the year. There are 69 oil maps, on the scale 1/9,504, whereon all additions and changes are annually recorded, the nature of the tenancy being shown in colour. Fifty-six copies were reproduced.

Plans.

One thousand and sixty-five grant plans were made during the year, together with numerous tracings. Transactions under the Real Property Ordinance involved the certification of 560 plans.

New Cadastral Maps.

The new maps based on rectangular co-ordinates will be prepared on the scales 1/2,500 and 1/10,000. A new scheme of scales, sheet dimensions and numbering has been evolved.

New Mapping Scheme.

Scale.	Sheet Reference Letter or No.	No. of Sheets.	Area Covered.		Size of Sheet.
			Chains.	Miles.	Inches.
1/50,000	A to H	8	1,800 × 1,500	$22\frac{1}{2} \times 18\frac{3}{4}$	28·512 × 23·760
1/10,000	1 to 25	200	360 × 300	$4\frac{1}{2} \times 3\frac{3}{4}$	,, ,,
1/2,500	A to P	2,000	90 × 75	$1\frac{1}{8} \times \frac{15}{16}$	,, ,,

Time.

The usual observations were taken for the control of time throughout the Island.

Expenditure totalled £6,817, of which £3,848 represents salaries of staff, £1,982 wages of extra staff, £655 travelling expenses, the remainder being mostly materials for surveys.

Uganda, 1924.

Governor	Sir G. F. Archer, K.C.M.G.
Director of Surveys and Land Officer	Mr. E. Richardson (until retirement).
,, ,, ,,	Mr. Dyson Blair.
Deputy Director of Staff ...	Mr. H. B. Thomas.
Assistant Director	Captain E. G. Fenning, D.S.O.
Assistant Land Officer ...	Mr. J. G. Strickland.
Conveyancer and Registrar of Titles	Mr. D. L. G. Williams.

Staff.

14 Surveyors.
1 Chief Draughtsman.
1 Office Superintendent and Storekeeper.
1 Computer.
3 Draughtsmen and 5 Clerks.

The nature of the work involves a strain on the health of the staff, illness amongst the Europeans rising this year to 16 days on the average of all the staff.

Revenue and Expenditure.

Revenue.

	£
Land Rents	19,449
Land Sales	300
Premiums on Leases...	1,887
Registration of Titles	1,020
Preparation of Deeds	1,578
Survey Fees	3,296
Miscellaneous ...	936
Total ...	£28,466

Expenditure.

	£
Personal Emoluments	18,808
Other Charges ...	3,007
Total ...	£21,815

Trigonometrical Survey.

Ten stations of the Secondary Chain from Toro to the Eastern Province were occupied, so that nine stations remain to complete the chain as far as the Nile. Thirteen triangles have been completed with a mean triangular error of $2''{\cdot}95$, a maximum error of $7''{\cdot}04$ and a probable error of $\pm\ 2''{\cdot}15$ per observed angle.

This chain is linked with 12 sides of the old Uganda triangulation, and shows that the scale of the latter is too small by 1/8,000 to 1/4,000—discrepancies averaging about twice the amount anticipated and traced in part to an error of standardisation in the measure of the Busowa base.

COLONIAL REPORTS—ANNUAL

No. 1383.

REPORT OF THE

Colonial Survey Committee

1927

(For Report for 1925 see No. 1286 (Price 1s. 0d.), and for Report for 1926 see No. 1325 (Price 1s. 3d.).)

LONDON:
PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh;
York Street, Manchester; 1, St. Andrew's Crescent, Cardiff;
15, Donegall Square West, Belfast;
or through any Bookseller.

1928

Price 2s. Net.

58-1383.

EMPIRE DEVELOPMENT

EMPIRE MARKETING BOARD PUBLICATIONS.

Note on the work of the Board and Statement of Research Grants approved by the Secretary of State from July, 1926 to May, 1927. Cmd. 2898. 3*d*. (3½*d*.).

Agricultural Economics in the Empire. (E.M.B. 1.) 6*d*. (7*d*.).

Tropical Agricultural Research in the Empire, with special reference to Cacao, Sugar Cane, Cotton and Palms. (E.M.B. 2.) 1*s*. 6*d*. (1*s*. 9*d*.).

Agriculture in Trinidad. Report on Development. (E.M.B. 3.) 3*d*. (3½*d*.).

Agriculture in British Guiana. Report on Development. (E.M.B. 4.) 9*d*. (10*d*.).

Agriculture in Leeward and Windward Islands and Barbados. Report on Development. (E.M.B. 5.) 6*d*. (7*d*.).

Geophysical Surveying. Report of a Sub-Committee of the Committee of Civil Research. November, 1927. (E.M.B. 6.) 6*d*. (7*d*.).

The Chemistry of Wine Making. A Report on Oenological Research. (E.M.B. 7.) 1*s*. 0*d*. (1*s*. 2*d*.).

Grass and Fodder Crop Conservation in Transportable Form. (E.M.B. 8.) 1*s*. 0*d*. (1*s*. 2*d*.).

IMPERIAL ECONOMIC COMMITTEE PUBLICATIONS.

The Imperial Economic Committee has issued a series of publications on the problems connected with the marketing and preparing for market of foodstuffs produced within the British Empire. The following six volumes are now ready. General Questions, 9*d*. (10*d*.); Meat, 9*d*. (10*d*.); Fruit, 4*s*. 6d. (4*s*. 10*d*.); Dairy Produce, 1*s*. (1*s*. 3*d*.); Fish, 6*d*. (8*d*.); Poultry, Eggs, Honey, 1*s*. (1*s*. 2*d*.).

The Eighth Report of the Committee, "The Functions and Work of the Imperial Economic Committee," 6*d*. (7*d*.). The relationship between the Committee and the Empire Marketing Board is explained in this Report.

All Prices are net. Those in brackets include postage.

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COLONIAL SURVEY COMMITTEE REPORT, 1927.

The Report covers for most of the territories considered the two years 1925 *and* 1926 *or* 1925-26 *and* 1926-27. *In the case of each territory the period reviewed depends on whether the departmental year there ends on the* 31*st December or the* 31*st March.*

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

W. C. BOTTOMLEY,
Chairman.

H. P. DOUGLAS,
Rear-Admiral and Hydrographer of the Navy.

E. M. JACK,
Colonel Commandant, and D.G.O.S.

H. St. WINTERBOTHAM,
Colonel, General Staff, War Office.

G. T. McCAW,
E. B. BOWYER, } *Secretaries.*

May, 1928.

AIR PHOTOGRAPHS FOR RECONNAISSANCE OR MAPPING.

The Colonial Office Conference, 1927.

1. The Colonial Office Conference of 1927 showed a general desire on the part of Colonial Authorities to obtain information as to the use and cost of air-photo surveys. Generally speaking there is little reliable printed information to be obtained. Such books as are available are, for the most part, written to explain and to advertise this or that machine or method. Official reports are reliable, but often fail to give a true economic picture. Generally, too, such reports deal with applications, scales, and orders of accuracy, desirable under special rather than average circumstances.

The general trend of questions at the Conference may be summed up as :—

I. What help in development can be got from air photography and air reconnaissance?

II. How much will that help cost in its various applications?

Photography and Reconnaissance.

2. *Responsibility.*—There are several processes in every air-photo survey. The flying and photography are the province of airmen; the control, surveys, fairdrawing and reproduction that of surveyors. The reconnaissance, if a technical judgment " at sight " is required, must be done by the responsible expert in forestry, soils, railway or road location, etc. The Colonial Survey Committee is in a position to answer questions on these points, referring, if necessary, to the Air Survey Committee, whose reports and professional papers form the best contemporary guide to possibilities, methods and processes.

3. *Characteristics of an Air Photo.*—Before discussing the questions raised it will be well to describe the characteristics of an air photograph.

(a) *Size and Scale.*—Cameras used in the air are made for sizes of plate or film varying from 7 × 7 inches to 4 × 5 inches. The scale at which they are taken depends on the height of flight and the focal length of the camera (or distance from plate to lens). The smallest scale normally taken may be considered as 1/40,000 (roughly $1\frac{1}{2}$ inches to the mile). Generally the scale is larger, averaging perhaps 1/20,000 (or 3 inches to the mile). At 1/40,000, roads, houses, streams, etc., are so small as to be hardly distinguishable. For very accurate surveys photographs must be taken on glass plates, for less accurate work and generally in all matters of reconnaissance on film. Whether on glass or film the original can be enlarged say 3 times and yet be used for good mapping. It would often be useful to photograph at a much smaller scale (say 1/80,000) and enlarge. Unfortunately that is not possible. The necessary altitude would

be too great, and the focal length necessary to cover the plate without distortion, too long. Every photograph taken may be considered to have on it about 4 square miles on the average, and as " overlap " is necessary, i.e., as each plate has to cover a portion of all the surrounding plates, we can take one photograph to each square mile of map or reconnaissance.

(b) *Tilt and Relative Heights.*—If the ground is as flat as Essex or Flanders, the photograph may be considered as a perspective view foreshortened in accordance with the angle at which the camera axis is tilted with regard to the plumbline, or at which the photograph is tilted with regard to a horizontal plane. It is extremely important that photographs should be taken as nearly as possible parallel to the ground, *i.e.*, without tilt. It is not possible to correct tilt afterwards without expensive work on the ground. Experience proves that with proper training pilots can fly within one or two degrees of the horizontal. If the ground is not flat, then the rays from the camera to objects not immediately underneath do not pass through the proper positions in plan, but show the summits, or top points, further away from the point vertically below the camera than they actually are in nature. It must be remembered that the photograph is a representation in two dimensions of the three dimensions of nature. Every photo is then characterized by two undesirable features—a foreshortening due to tilt (which cannot be wholly avoided) and a distortion due to relative height which is worst near the edges. But it is from this actual height distortion that contours are surveyed. In order to complete the contour survey, and to correct the plan, each part of the area must appear not only on one but on two photographs taken from different points in the air. These two views of the same portion, or area, may then be put in a stereoscope and will give a relief (or plastic) image of the ground.

(c) *Effect of* (a) *and* (b) *on Specifications for Photography.*—The above summary will show that in ordering air photographs two important points to specify are :—

1. The photographs must in no case show tilts of over 3 degrees and the average tilt must not exceed 1 degree.

2. Photographs must have at least 60 per cent. overlap in the line of flight and 15 per cent. laterally.

The cost of such photography depends on a number of factors of which landing grounds, aerodromes, transport of petrol and oil, and the size of the contract are the most important. A low price would be £3 a square mile.

(d) *Effect of Atmospheric Conditions.*—A photograph will vary considerably in value acording to atmospheric conditions. It cannot be taken until some hours after dawn, or after some early

A quadrilateral connecting the Uganda triangulation with the Anglo-German Boundary Chain in the vicinity of Entebbe was re-observed; the results appeared to indicate failure to discover the old stations, and are a further instance of the future trouble caused by imperfect marking. It is hoped that a connection may be established elsewhere.

The Ankole triangulation was adjusted to Arc of Meridian values, the sides being lengthened on an average by 1/20,000.

A summary of results, containing geodetic positions, rectangular co-ordinates, azimuths and grid bearings, now includes 109 trigonometrical stations. An alphabetical index of 405 intersected points in Toro was also prepared.

Topographical Surveys.

Two hundred and sixty-five square miles of topography were completed in eastern Toro.

Cadastral Surveys.

Trigonometrical control covered 65 square miles in Kyagwe and 291 square miles in Buyaga; in the unhealthy Bulemezi country the control had to be established by theodolite traverse. Five hundred and forty-eight square miles were covered during the year at an average rate of 150 square miles per officer per annum. Eight thousand eight hundred and eighty of the 16,830 square miles of the Kingdom of Buganda are now completed. The cost of the Mailo Survey in the Buganda Kingdom during the year was £11 5*s*. per square mile.

For the control of the cadastral survey in Toro, officers break down the minor triangulation of the topographical survey. Standard plane-table sheets, containing 3 minutes of latitude and 3 minutes of longitude, are prepared on the scale of 1/20,000 to show all claims. One hundred and thirteen square miles of native claims were surveyed during the year; the total area of all claims in Toro surveyed up to date amounts to 362 square miles.

Crown Lands.

There was little work done in this branch save the survey of some small lots, ginneries, etc.

Drawing Office.

The number of sun-prints was 5,830. Forty-six plane-table sheets of the 1/10,000 Mailo Survey of Buganda have been traced, reduced and incorporated in the 1/50,000 series. A large wall-map of Uganda Protectorate was received during the year.

hour in the afternoon, depending on the strength of the light. Even in the best of climates, days for photography have to be picked. In England there may be a good day once a fortnight, in a Canadian summer twice a week, etc. The quality and sharpness of each photograph depends primarily on the " light value ".

(e) *Value of the Single Photograph.*—Once taken, the photograph records with extraordinary effect every detail to be seen. The effect of seeing a large area at once, directly from above, makes it possible to identify characteristics in a way impossible from any point of observation on the earth. Thus the prevalence of a certain type of tree, the general character of the soil, the presence of marsh, rocky outcrop, cultivation (and often the particular sort of cultivation), tracks both in use or even long abandoned, new or old earthworks such as old irrigation channels, are all matters which have been studied from air photographs.

(f) *Use of the Stereoscope.*—The photographs having been examined singly, a subsequent examination of overlapping pairs in the stereoscope will show the drainage system, hill and valley, relative steepness of slope, the strike, the most likely path for road or railway, relative easiness of defiles, and will help to determine correctly the purpose or character of artificial or natural detail.

(g) *The Photograph as a Record.*—The photograph remains a definite record of all natural features at the date of exposure. It may be used at any future time for further (perhaps larger scale) mapping. The photograph cannot, of course, record what it cannot see. Areas of really dense forest, as in Johore and perhaps in Brazil, form an impenetrable screen. If the trees are not in leaf, or if they are sufficiently spaced out, the stereoscope will penetrate them, even if, used singly, the photographs show little.

(h) *Photographs of Under-Water Objects.*—In photographing land under different conditions of atmosphere and light considerable experience has now been gained. There is, so far, little known about photographing objects under water. Experiments are now in contemplation. We know that, if the light is good and the water calm and clear of sediment, much can be seen. Mud-banks, shallows and rocks have been found. We have not yet tried what effect the stereoscope will have, nor has any real consecutive research been directed to this subject.

4. *Mosaics.*—The next stage is the mosaic, a word usually employed for a patchwork of uncontrolled air photographs. A mosaic is often very useful in flat country, and, if well made, may be traced and reproduced as a rough preliminary map. For the reasons given above, a mosaic is never precise in detail. It is common to tender for " rectified mosaics ". The term is neither

correct nor self-explanatory. It is intended to describe a mosaic in which, either singly or in strips, the mosaic has been made to agree in scale with the position of control points. In England such " rectified mosaics " are made on the control of Ordnance Survey maps. In unmapped areas the control is generally one of scattered control points, either of the local triangulation, or of astronomically fixed positions. The latter form of control is quite suitable for the purpose of preliminary mapping. The normal class of error of astronomical fixing may be taken as 150 yards (in any direction), and if the points are widely spaced (say, 10 miles apart) they will form an adequate control in position and orientation for the mosaic. Commonly, however, mosaics are made by the fit of detail between successive prints. This principle is wrong in theory and leads to a loss of direction in individual strips. The natural consequence is that the detail, in the intervals between strips, is distorted and may have to be enlarged or reduced in comparison with the correct scale. It should be stated, then, that mosaics should be made from photographs with sufficient overlap to allow of the use of the methods given in professional paper No. 3 of the Air Survey Committee.

5. *Addition of Form Lines with the Stereoscope.*—Useful as a mosaic may be, it can show no heights. Rough form lines can be added, however, from the stereoscopic examination of overlapping pairs. Extra untrimmed photographs should be secured with the mosaic in order to make this examination possible.

Air Photo Survey.

6. *Canadian Oblique Method.*—So far no actual survey methods of plotting or mapping have been mentioned. These methods naturally vary considerably in precision and cost. The cheapest method generally employed is one used in Canada for making quarter-inch maps of the river and forest country in Northern Ontario and Quebec. This method is purely perspective and assumes that the area to be mapped is quite flat. The photograph is taken at a considerable tilt so as to include the horizon and thereby to help to " control " the result. In reality the method boils down to copying, in a grid of squares, the details of the photograph over which a glass perspective of that grid of squares is laid. The one difficulty is in designing and drawing the perspective glass grid. Originally due to Doctor Deville of Canada, this method is admissible, provided that :—

(*a*) The ground is flat and no contours are required;

(*b*) The visibility is very good;

(*c*) The detail to be mapped is sharp and clear (like the water edges of the Canadian lake country);

(*d*) The final scale is small.

This method requires very little control (say, one point every 20 or 30 miles) and should not cost more than 10s. a square mile extra to the cost of photography. It has recently been used in Northern Rhodesia, but it is not known what success has been achieved. It is possible that the Sudd region of the Sudan might be mapped in this way, but the method will not find a general sphere of usefulness because of the large distortions which heights are bound to introduce at so large a tilt. Details may be studied in the following publications :—

(*a*) Report of the Canadian Air Board for 1923.

(*b*) Graphical Plotting from Air Photographs (H.M. Stationery Office).

7. *Arundel Method.*—A useful topographical method, now generally known as the Arundel method, is described in professional paper No. 3 of the Air Survey Committee. The only instrument required is the topographical stereoscope. Good and well-contoured maps have already been made in this way. A control of one point every 10 miles is required to start with, and perhaps additional points may be required subsequently. A fairly dense control of heights is wanted, however, if the contours are to be good. This control of heights need not necessitate any more bulky instrument than one field and one office set, or " battery " (say, three in number), of aneroid barometers. Generally speaking, the original plotting will be at the scale of the photographs themselves, and there is then material at once for a map at any medium scale between 2 and 6 inches to the mile. In an experimental survey in England on these lines the cost of field work *plus* plotting worked out at about 15s. per mile, additional to the cost of air photography. In most cases costs will be found to exceed this total. The party engaged were all highly skilled and worked harder and for longer hours than could be normal. Theoretically this method is admissible only in country in which altitudes (above the general level, not above mean sea-level) are not more than 1/10th of the height of flight. The result should give contours correct to within 15 feet and the plan should be sensibly correct. Further experiments are being undertaken with a view to seeing whether this method can be modified for use in more hilly country. There is no doubt that we have here a very good way of making topographical maps. It must be understood, however, that all who take part—from pilot to draughtsman—must be highly trained. Courses of about a fortnight in duration are sufficient to introduce skilled surveyors and draughtsmen to the theory and method, but practice is essential before a really reliable map can be made. Experienced surveyors agree that the contours so surveyed are, on the whole, an excellent guide to local feature and compare well with those made on the plane table. The sample map in the Air Survey Committee's report is not typical of the possibilities, as the original photographs were

ill-defined. The style of map just described is not perhaps precise in the strict sense of the word. It will not suffice for the final survey of a railway when the ultimate choice of route has been made, nor will it contour sufficiently closely for some economical purposes.

8. *Precise Methods.*—More precise surveys can be made from air photographs, but at a greater cost. To start with, the Arundel method will give sensibly accurate planimetry at any scale, and, when the final plan has been made, it can be contoured on the ground. A mixture of survey on these lines has just been applied to mapping in the Essen district in Germany. There are, in addition, various firms in France, Germany, Italy, and the United States which specialise in machines, or in work done by machines, for complete, and more or less precise, plotting. Some of these machines do reliable work, although it is doubtful whether contouring usually attains the accuracy claimed by advertisement. The drawback in all cases is the amount of control required. They all rest upon " placing " each photograph on a control of four points (say, one per sq. mile). Now a control of such density is bound to be costly and to take time. A method of Air Survey should be designed to work with the ordinary open control given by a second order triangulation (say, 10-mile sides). There are two main principles at the bottom of this statement. The first is economy, the second the theoretical advantage of a longer ground base. One photograph covers but a small area, and the camera in the aeroplane is a long way above it. The control is thus a weak one. Fortunately there is hope that a machine designed recently by Mr. Fourcade, and being built in England, will be capable of precise plotting from an open control. It would be wise in the meantime to await the result of research on this new model before embarking upon large-scale precise air surveys.

To recapitulate then :—

9. *Ground and Air Costs.*

(a) **Air Costs.**

Air photography may cost from £3 upwards per sq. mile, although always substantially above that figure in small contracts or far from aerodromes and bases.

A good mosaic and additional pairs of overlapping prints will add from 5*s.* a sq. mile.

A plotted small-scale map on the Canadian principle, including control, will add from 10*s.* a sq. mile.

A plotted 3-inch Survey, Arundel method, will add from £1 upwards per sq. mile.

Compare the above with the following recorded ground costs :—

(b) **Ground Costs.**

Scale.	*Country.*	*Type.*	*Cost of Plane-tabling, per square mile.*	*Cost of Control per square mile.*
(*a*) ½ inch ...	South Africa.	Very easy.	5s. 6d.*	2s. 4½d.*
(*b*) 1 inch ...	India.	Easy.	10s.	3s.
„ „ ...	„	Average.	15s.	
„ „ ...	„	Difficult.	35s. to 50s.	
(*a*) 1 inch ...	East Africa.	Very easy.	6s. 6d.*	8s. 6d.*
(*b*) 1 inch ...	India.	Easy.	15s.	12s.
„ „ ...	„	Average.	25s.	
„ „ ...	„	Difficult.	40s. to 100s.	
„ 2 inch ...	India.	Intricate, open hills in the area of dense forest.	80s.	No data.
„ „ ...	Burma.	Forest reserves.	£4 to £25.	No data.
(*a*) 3 inch ...	Malaya.	Very difficult.	£47 to £50.	Included in previous figure.

Notes.—(*a*) Colonial Survey Sections—British Military personnel.

(*b*) Survey of India—taken from Records, 1921-22—Indian Planetablers.

* Pre-war. Add 70 per cent. to bring to modern conditions.

10. *Remarks on Costs.*—It is not wise, however, to judge from the figures given above for ground surveys unless a party of really skilled topographical surveyors is available. Normally the civil surveyor does not start with experience in drawing and is too unskilled on the planetable to be economical as a topographer, but that does not imply that a small scale (say, one-inch) map, made by normal graphic planetabling, will not be cheaper than air-photo surveying. The first map, for administration and for development, should be made, in easy country, on the planetable, but it will generally be wise to secure military parties or to train native planetablers as is now being done in many places. Planetabling is a real craft, and requires skilled fingers and an instinctive or trained eye for country, but it does not require the services of a highly-educated man.

On the other hand, air-photo surveying will compete, economically, at its best scales (three to six inches) with any other form of surveying and is vastly quicker. In addition, the air photo is peculiarly suitable in surveys of :—

1. Townships (especially large towns with narrow streets);

2. Waterways, marshes, irrigation channels, estuaries, deltas, and coastlines;

or, in fact, any area difficult to penetrate or to see clearly from the ground. For cadastral surveys the photograph has the additional advantage of making collusion practically impossible.

11. *Railway Reconnaissance and Surveys.*—At the 1927 Conference particular interest was shown in the question of road and railway reconnaissance. Actual reconnaissance from the air will help in the first instance. A study of overlapping pairs in the stereoscope will aid in the selection of one or two alternatives and in the rejection of unsuitable routes, whilst a survey on the Arundel method, quickly completed, will save any ground survey except in the case of the final choice.

12. *Literature.*—The following books are recommended :—

1. Report of the Air Survey Committee for 1923. (His Majesty's Stationery Office, price 4*s*. 6*d*.)

2. Professional Paper No. 1 : Graphical Methods of Plotting from Air Photographs. (His Majesty's Stationery Office, 3*s*. (3*s*. 2*d*.).)

3. Professional Paper No. 2 : Flying for Air Survey Photography. His Majesty's Stationery Office, 2*s*. (2*s*. 1½*d*.).)

4. Professional Paper No. 3 : Simple Methods of Surveying from Air Photographs. (His Majesty's Stationery Office, 3*s*. 6*d*. (3*s*. 8½*d*.).)

5. Professional Paper No. 4 : The Stereoscopic Examination of Air Photographs. (His Majesty's Stationery Office, 3*s*. 6*d*. (3*s*. 8½*d*.).)

(All prices are net and those in parenthesis include postage.)

In addition to the above, there are available on demand reports and articles on *all aspects* of air photo surveying.

COLONIAL SURVEY REPORTS.

British Honduras, 1925-26.

Governor.—Major J. A. Burdon, C.M.G.
Surveyor-General.—Mr. F. W. Brunton.

Staff.—This is made up of 3 Surveyors; 3 Draughtsmen; 4 clerks; 1 temporary Inspector of Crown Licences; 2 messengers. An appointment of Assistant Surveyor remains vacant.

Expenditure (1) *and Revenue* (2).—

			$
(1) Personal Emoluments			17,552
Other charges :—		$	
Travelling		2,280	
Surveys		5,330	
Instruments, Stores, etc. ...		560	
Rent Collection		298	
Boundary Demarcation ...		300	
Trigonometrical Survey ...		115	8,883
Total ...			$26,435
		$	
(2) Royalties from Mahogany ...		24,109	
Royalties from Sapodilla Gum ...		1,050	$
Royalties from Cedar and Rosewood		43	25,202
Rent of Crown Lands			13,4[illegible]
Sale of Crown Lands			1,726
Sale of Leases and Licences, plans, etc. ...			2,329
Petty Licences			691
			$43,384

Trigonometrical Survey.—This work was begun in October, 1925, after a decision to start on the line from Belize to Garbutt's Falls. A site for a base was chosen on the western side of Manatee Northern Lagoon.

Traversing.—85½ miles of road traverse were measured, including the line from Belize to Orange Walk on the proposed Corozal main road.

Other traverses cover 34½ miles and comprise 10 miles of the western boundary, which has now been recut up to within 10 miles of the Mexican frontier.

Cadastral Work.—The common routine was followed, two small areas in Toledo District and 11 town lots in Punta Gorda being surveyed. Applications, leases, licences, etc., were dealt with as usual.

British Honduras, 1926-27.

Governor.—Major Sir J. A. Burdon, K.C.M.G.
Surveyor-General.—Mr. F. W. Brunton.

Staff.—The staff was the same as the year before, save for the departure of one messenger.

Revenue and Expenditure.—The revenue, made up from the same sources as recorded last year, fell by $7,370. Expenditure rose by $2,410, all of which was offset by a saving from the previous year.

Trigonometrical Survey.—This survey—a necessary preliminary to future development—was well begun by the measurement of the Manatee Base, 15,900 feet long, which showed a probable error of 1/780,000. Permanent concrete terminals were set up and connected by a double line of levels, 36 miles long, with Mean Sea-Level at Government House Grounds. Four Europeans took part in the measurement of the base (which was pegged at every 100 feet to facilitate progress), since apparently native labour is not sufficiently expert for minor operations.

The reconnaissance of the base extension and of four of the main stations was executed on the planetable, showing that a satisfactory chain was obtainable.

Levelling.—A portable automatic tide-gauge had been purchased and installed at Belize the previous year; its records will be available in three or four years for a precise determination of Mean Sea-Level. A permanent Bench-Mark was fixed in the vicinity so that the zero of the gauge and the local levels of the Colony can be referred thereto at any time. Levelling to the Manatee Base gave a closing error of 0.005 foot (1 inch/16) per mile. Since the closing of a double line of levels may be accidental, the average closure of sections or the mean square error is a better index to accuracy in the absence of circuits.

Traversing.—A further length of the western frontier—26¼ miles—was opened, but lack of water prevented the traverse from reaching the Mexican border. 5¼ miles were traversed to the village of Pueblo Viejo.

Positional Work.—A W/T. receiving set was constructed locally with the aid of the Superintendent of Radio—an excellent example of accomplishment by small means. With this apparatus the positions of Gracias-a-Dois Falls, Garbutt's Falls (two important sites in the Colony), and Pueblo Viejo were fixed astronomically.

Cadastral Work.—Various parcels of land in Belize, Mesopotamia (soldier settlement), Fort George, and Stann Creek were measured or resurveyed.

Land Administration.—The control of Forest Licences passed to the Forestry Department. 602 applications for land were dealt with and the records of fiats, licences, leases, etc., kept up to date.

Maps and Plans.—In addition to various local plans, tracings, etc., the Department prepared a contour map of the Colony, a general map at 16 miles/1 inch, and two geological maps.

Remarks.—The year constitutes a landmark in the history of the Survey, and the Surveyor-General is to be congratulated on the clear evidence of fruitful enterprise and enduring progress.

Ceylon, 1925-1927.

Governor.—Sir Hugh Clifford, G.C.M.G., G.B.E.
Surveyor-General.—Mr. A. J. Wickwar, F.R.G.S.
Deputy Surveyor-General.—Mr. A. H. G. Dawson.
Assistant Surveyor-General.—Mr. C. R. Lundie, A.M.I.C.E.
Superintendent of Observatory.—Mr. A. G. Bamford, B.A.

Staff.—Field.—12 Superintendents of Surveys. 40 Assistant Superintendents of Surveys. 290 to 320 Grade Surveyors.

Office.—4 Assistant Superintendents (Headquarters). 1 Superintendent of Instruments. 1 Accountant. 450 Clerks and Draughtsmen.

Observatory.—1 Superintendent. 1 Astronomer. 4 Technical Assistants.

Topographical Surveys.—During the year 1925-26, thirty-seven square miles, comprising the small islands in the north, were surveyed on the 1-inch scale and 2,518 acres of Jaffna town on the 16-chain scale, thus completing the topographical revision survey of the Island. All sheets have been published. The topographical staff consisted of 2 Grade Surveyors in charge of 10 Surveyors. No figures as to cost are available.

Cartography.—The new large-sheet 1 inch to 1 mile series is gradually replacing the small-sheet series. The sheets of the new series are printed in colours and show contours and cultivation.

At the present rate of progress in reproduction, the whole island should be covered by the new series by the end of 1928.

Triangulation.—Minor triangulation schemes for the control of Block Survey traverses were carried out in several provinces during the year 1926-27; the total area covered was 350 square miles, 26 new observing stations and 71 intersected points being fixed.

The average angular misclosure in 120 triangles was 3.3 seconds. No figures are available to show the cost of these local triangulations.

Levelling.—The levelling staff was employed up to the end of December, 1925, in bench-mark construction. During the year 1925-26 34 fundamental bench-marks were constructed of a design similar to that adopted by the Ordnance Survey.

Intermediate bench-marks were constructed along 403 miles of road, and, in addition, the bench-marking of 346 miles of road to be relevelled was supplemented by new type bench-marks.

Field work commenced in February, 1926, and during the year, 481 miles of road with Kurunegala as centre were levelled and a start was made on the road from Diyatalwa to Badulla. All lines, with the exception of two, were levelled forward by one surveyor and back by another. The permissible discrepancy between forward and back levellings was calculated from the formula .005 $\sqrt{F}$ feet (where 1,000 F is the distance in feet between bench-marks).

The misclosures, uncorrected for errors in the graduation of the staves, obtained in five circuits were :—

Circuit.	Length Miles.	Misclosure. Feet.
S	74	0.200
T	107	0.149
F	138	0.126
G	125	0.006
H	153	0.010

or an average error of .002 inches per mile.

In November the calibration of staves, with reference to one standardised at the National Physical Laboratory, was taken in hand. All levelling in the future will be done with calibrated staves and the corrections given to the staves when calibrating them will have to be applied to all previous work.

During the year, 22 fundamental and four standard bench-marks were constructed. The latter consist of concrete blocks and are used where no rock formation could be found. Intermediate bench-marking was carried out along 720 miles of road, leaving only 262 miles of the level net to be completed in 1927.

Tide Gauges.—At Colombo the Harbour Works automatic tide gauge has not proved satisfactory for a redetermination of mean sea-level and it has been found necessary to construct a new well. At Trincomalee permission is being sought from the Admiralty to erect a tidal observatory in the Naval Dockyard and an automatic tide gauge for this Station is on order.

Cost of work.—

Levelling.—Rs.100/59 or £7 10s. per (double) levelled mile.

Bench-marks.—Rs.812 or £61 per Fundamental Bench-mark.

Rs.60 or £4 10s. per Standard Bench-mark.

Rs.12/70 or 19s. per Intermediate Bench-mark, or approximately Rs.26 per mile.

Block Surveys.—In 1925, 131,875 acres were block surveyed and settlement surveys were carried out in 160 villages covering 270,912 acres. In 1926, 133,907 acres were block surveyed and the settlement surveys covered 19,940 acres. The detail work for these surveys is carried out by parties averaging 10 surveyors

under an Assistant-Superintendent and is based on rigorous traverses connected to trigonometrical stations, the maximum error allowable being three links per mile. The average cost of these surveys is a little over Rs.5 or 7.5 shillings per acre.

Town Surveys.—In 1925, town surveys were carried out over an area of 2,356 acres. No surveys of this description were made in 1926.

Application and Miscellaneous Surveys.—4,162 applications were made in 1925 and 5,894 in 1926, when 22,400 acres were surveyed at a cost of Rs.22 or 33 shillings per acre.

Wireless Work.—From 1st October, 1925, wireless time signals were sent out on 2,300 C.W. at 11.30 a.m. instead of at 11.30 a.m. and p.m., and 600 spark at 10.30 p.m. instead of at 10.30 a.m. and p.m.

The transmission of signals is improving. From April, 1926, to the end of the year the total number of failures and omissions was 15 out of 275 signals.

A six-valve receiving set has been installed at the Observatory, and signals from Bordeaux and Saigon can be heard. The Observatory participated in the International Longitude Determinations in October-November, 1926, and from the results obtained Ceylon appears to be roughly 200 yards further west than was previously supposed.

Meteorological Service.—Work continued as usual and as in previous years was supplemented by the reports of a large number of voluntary rainfall recorders.

Remarks.—An efficient network of levels is being rapidly run across the Island, but no consideration seems to have been given to the question of the re-observation of the triangulation net.

It is understood that some policy as to the periodic revision of the 1-inch topographical sheets in the field has been adopted, but it is not clear to the Committee what this policy is, nor to what extent revision work has been carried out during the period under review.

Cyprus, 1925-26.

Governor.—Sir Malcolm Stevenson, K.C.M.G.
Registrar-General and ex-officio Director of Surveys.—Mr. B. T. Watts.
Assistant Director of Surveys.—Mr. P. E. L. Gethin.

Organization.—Since the last report there have been a few minor alterations in the personnel of the three branches of the Department. The strength of the Survey Branch was reduced by the Surveyor 2nd Grade, who was previously employed in the drawing office, and two native surveyors (temporary).

Expenditure.—

	£
I.—Survey Branch	11,293
II.—Valuation Branch	2,979
III.—General Registration Branch	3,170
Total	£17,442

The cost of Administration, Stores, and Pay Officers has been set proportionately against the three headings.

Survey Branch.—During the year the Field Section was organised in two parties, one employed on village and detail chain survey and the other on planetable work.

The country under survey was similar to that encountered the previous year, very rugged with many small holdings, so that progress was slow. The work carried out by the Survey Branch is summarised under :—

(a) *Trigonometrical Section.*—In the Marathasa Valley and Papho-Kykko Forest area, 166 fourth-order points, covering an area of 54 square miles, were fixed and observed by one Surveyor during a period of three months, though 17 days of this was spent in repoling and observing third-order points that had been blown down.

The cost was £117, or £0.70 per point, observed with a Troughton and Simms 6-inch micro theodolite.

A Brunsviga machine was used for computing the position and heights of the fourth-order points.

(b) *Planetable Survey at* 1/5,000.—This comprised the rugged area south of and including Adelphi Forest, the Evrychon Valley, and the more open country round Levka. An area of 94,333 acres (32,755 acres of forest included) was surveyed in 124.8 man-months. The average size of cultivated plots was 1.11 acres and of uncultivated plots, 9.4 acres. The total cost of the work was £4,072, or about 10*d.* an acre, or £27 a square mile.

(c) *Traverse and Survey of Villages and Village Gardens.*—Eight villages were traversed in 2½ man-months by theodolite and chain, 73 points being fixed per village and the chainage averaging 5.3 miles per village. The total chainage for the village garden traverses was 164 miles, 2,024 points being fixed in 14 man-months.

Eighteen villages averaging 26 acres in area and 172 plots per village were surveyed in 14.4 man-months at a scale of 1/1,250. 637 acres of village gardens were also surveyed in 36 man-months.

The total cost of traverse and survey was £895.

(d) *Detail Chain Survey, Scale* 1/2,500.—In five months one man traversed 96 miles with theodolite and chain, fixing 608 points, and in 12 months three men chain surveyed an area of 2,846 acres.

The total cost of the detail chain survey was £3,245.

(e) *Examination.*—During the year, 37 villages, 114 planetable plans and 240 acres of detail surveys were examined by the two officers in charge and their assistants.

(f) *Varosha Town Survey on a Scale of* 1/1,000.—The survey of a portion of this town was carried out by two men, 136 acres being covered in three weeks. The cost was £65, or about 10*s.* an acre.

(g) *Topographical Survey.*—About 1,400 square miles were reduced during the year from the 1/5,000 scale to one of two inches to one mile, and 146 square miles were contoured in the field.

(h) *Drawing, Plotting, and Computing.*—

RECORD OF WORK.

Nature of Work.	*Clerks employed.*	*Scale of Plans.* 1/1,000.	1/1,250.	1/2,500.	1/5,000.	1/31,680
Plans plotted by co-ordinatograph	1	26	27	9	68	4
Area plotted (acres) ...	3	877	750	1,610	—	—
Plans checked (No.) ...	1	—	32	—	119	—
Plans fair-drawn (No.)	3	25	30	1	112	—
Plans typed (No.) ...	3	25	39	1	110	—
Plans examined (No.)...	1	19	47	1	121	—
Plans sun-printed (No.)	1	152	524	104	1,792	Various 597
Areas computed (acres)	3	75,645 of cultivation, 9,970 of uncultivated land, 10,921 of forest.				

Valuation Branch.—The valuation of the whole of the Kyrenia District was completed and the general rate of taxation (*Verghi Kimat*) adopted as from 1927.

The valuation of the Nicosia and Papho Districts was continued.

General Registration Branch.—During the year, 20,992 title deeds were issued for 17,277 plots. The average daily output in title deeds per clerk was nearly 13, and the registration fees collected during the year amounted to £1,011.

Cyprus, 1926-27.

Governor.—Colonel Sir Ronald Storrs, Kt., C.M.G., C.B.E.
(Assumed duty 30th November, 1926.)

Registrar-General and ex-officio Director of Surveys.—Mr. B. T. Watts.

Assistant Director of Surveys.—Mr. P. E. L. Gethin.

Organisation.—No important alterations have been made in the organisation of the Department since the last Report.

Expenditure.—	£
I. Survey Branch	10,901
II. Valuation Branch	2,840
III. General Registration Branch	3,147
Total	£16,888

The cost of Administration, Stores, and Pay-Officers has been proportionately divided under the three headings.

Survey Branch.—During the year the survey of all cultivated lands required mainly for valuation purposes was completed and the planetable personnel were transferred to Forest Surveys. The detail survey on scales of 1/2,500 and 1/1,250 of the Solea and Marathassa valleys was completed. As before, the country under survey was of a very rugged nature, the valleys being deep and composed mainly of small gardens.

The resurvey of Nicosia Town has been commenced. As no records were made at the time of its original survey in 1911-12 it was found impossible to add new detail to the old plans with any degree of accuracy, and the disappearance of many of the traverse points added to the difficulties in areas outside the ramparts which have now become valuable building sites.

These difficulties show the necessity of keeping proper records and of erecting permanent marks over survey points.

The work carried out by the Survey Branch is summarised under :—

(a) *Trigonometrical Section.*—In the central area of the Paphos Forest 246 fourth-order points covering an area of 62 square miles were fixed and observed during a period of 104 days, 30 of which were spent in repoling and observing third and fourth-order points that had been blown down or destroyed.

The cost was £172 or £0.70 per point, observed with a Troughton and Simms 6″ micro theodolite.

As before the positions and heights of all points were computed by means of a Brunsviga machine.

(b) *Planetable Survey at* 1/5,000.—This comprised the rugged area south and east of Troodos, including the Troodos Forest, the Marathassa valley, and the east side of the Papho Forest. Rain and snow retarded the work during February, 1927. An area of 59,182 acres (42,704 acres of forest included) was surveyed in 87.6 man-months. The average size of cultivated plots was 0.97 acres and of uncultivated plots 4.26 acres. The total cost of the work was £2,657 or about 11*d.* an acre or £29 a square mile.

(c) *Traverse and Survey of Villages, Village Gardens, and Irrigated Fields at* 1/1,250 *and* 1/2,500.—Eight villages were traversed in five man-months by theodolite and chain, 94.6 points being fixed per village and the chainage averaging 3.5 miles per village. The total chainage for the village garden traverses was 48 miles, 1,704 points being fixed in nine man-months. Twenty villages averaging 35.2 acres in area and 202.9 plots per village were surveyed in 31.2 man-months.

Two thousand four hundred and seventy-nine acres of village gardens and irrigated lands were also surveyed in 52.8 man-months.

The total cost of these surveys was £3,829.

(d) *Examination.*—During the year, 21 villages, 80 planetable plans, and 2,479 acres of detail surveys were examined by the two officers in charge and their assistants.

(e) *Resurvey of Nicosia Town on* 1/500.—566 points were fixed in six man-months, the total chainage being 26.5 miles at a cost of £229 or £8.6 per mile.

The average chainage error of the main lines was one in 4,500.

(f) *Topographical Survey.*—About 825 square miles were reduced during the year from the 1/5,000 scale to one of two inches to one mile.

(g) *Plotting, Drawing, and Computing.*—

		Record of Work.					
	Clerks	*Scale of Plans.*					
Nature of Work.	*employed.*	1/500.	1/1,000.	1/1,250.	1/2,500.	1/5,000.	1/31,680.
Plans plotted by co-ordinatograph (No.)	1	1	1	43	17	57	10
Areas plotted (acres)	4	—	—	1,087	2,033	—	—
Plans checked and numbered (No.) ...	1	—	—	29	16	106	—
Plans fair-drawn (No.)	3·63	—	23	40	13	92	—
Plans typed (No.) ...	2·24	—	23	23	8	87	—
Plans examined (No.)	·82	—	17	23	—	75	—
Plans sun-printed ...	1	—	129	394	145	2,042	
Areas computed (acres)	3·3	49,351 of cultivation, 6,970 of uncultivated land, and 2,590 of forest.					Various 623

Valuation Branch.—The valuation of the Nicosia and Papho Districts continues.

General Registration Branch.—During the year, 26,871 title deeds were issued for 15,583 plots and the registration fees collected amounted to £2,362.

Federated Malay States and Straits Settlements, 1925 and 1926.

Governor of the Straits Settlements and High Commissioner for the Federated Malay States.—Sir Laurence N. Guillemard, G.C.M.G., K.C.B.

Surveyor-General.—Mr. V. A. Lowinger.

Assistant Surveyor-General.—Mr. C. J. Perkins.

Assistant Surveyor-General, Topography.—Mr. J. N. Sheffield.

		Expenditure.	*Re-imbursement.*	*Per Cent.*
		$	$	
1925.	Federated Malay States	1,450,393	374,506	25
	Straits Settlements ...	477,305	60,803	12½
1926.	Federated Malay States	1,581,943	494,124	31
	Straits Settlements ...	460,974	92,805	20

Trigonometrical.—Federated Malay States.—No trigonometrical work was undertaken in either 1925 or 1926, with the exception of the provision of secondary and tertiary points for Pahang and standard levelling in Kinta.

Straits Settlements.—No trigonometrical work was undertaken.

Photo-Litho Department.—The demand for maps and plans has increased steadily and is being met by the addition of a new printing press and encouraged by a Map Sales Office in Ipoh.

The standard of map production is high, both in drawing and in lithography, and the general appearance of the maps produced is very pleasing. In the one inch to one mile map of Singapore and Johore, now in the course of production, more detail has been shown than the scale allows; this arises from the difficulty of generalising from large-scale material. But, considering the amount of information, the map is clear and legible. This is mainly attributable to the excellent and delicate colours (a recognised feature of Federated Malay States publications), to the bold yet neat type, and to the expressive symbols.

Instrument Repair Section.—With the exception of theodolites and levels, all instruments now used in the field are made in this Section, which appears to be fully justifying its existence.

The theodolites and levels are also periodically overhauled and examined, which adds greatly to their life and value.

Topographical, 1926.—

	Square Miles.	*Cost per Square Mile.*	*Square Miles, per Man, per Month.*
		$	
2 in. to 1 mile Standard Sheet—			
Kedah...	352	115	4·0
Pahang	622	—	2·77
4 in. to 1 mile—			
Penang	34·6	—	·75
Town surveys at various scales	2·1	—	—

A certain amount of miscellaneous surveys and revision was also undertaken.

The main factor both in trigonometrical and topographical work was the extreme difficulty of recruiting coolies, due largely to the high wages now paid by prosperous rubber estates, and also in part to the fact that the old time " up-country " Malay appears to be dying out. There is no doubt that the provision, if necessary by importation, of a suitable type of labour is a problem which requires much thought in the future.

In the case of the Federated Malay States, about 33 per cent. of the total area has now been mapped on a standard scale of 1 inch to 1 mile.

The trigonometrical work consists of a main geodetic chain covering the whole peninsula. Secondary and tertiary trigonometrical control is undertaken just before the topographical work in any given area is undertaken, and the proportion of the country covered by secondary control is only slightly in excess of that actually mapped on the standard scale.

An excellent table is given in the report, showing all the necessary statistical details of surveys in hand, an example which might be followed by many other Survey Departments.

The 4-inch to one mile survey of Penang Island shows a monthly out-turn of three-quarters of a square mile per man, which, even allowing for the difficulties of the terrain, seems unaccountably low.

Revenue Surveys.—This Branch surveyed in 1925, 6,923 lots for alienation, with an acreage of 45,608 and 200,000 acres of forest reserve land.

In 1926 there was a large increase in applications for survey, due to the prosperous condition of the country.

The reimbursements from Revenue Survey sources amount to nearly $300,000 for 1926, as against an expenditure of $820,000.

The detailed statement as to the position of Revenue Surveys, with reference to the requisitions received, is clear and concise and indicative of good organization. The report shows evidence of an efficient Department.

Fiji, 1925.

Governor.—Sir Eyre Hutson, K.C.M.G. (from April, 1925).

Commissioner of Lands.—Mr. C. A. Holmes.

Staff :—

Surveyors, 1st Grade	5
Surveyors, 2nd Grade	5
Surveyors, 3rd Grade	1
Cadets	2
Draughtsmen	2
Draughtsmen, 2nd Grade	2
Native Draughtsmen	1
Clerks	2
Messengers	1
Total	21

Of these, eight surveyors and the native draughtsmen are engaged on the Tribal Boundary Survey.

Minor Triangulation.—The Trigonometrical Survey of Fiji, including the principal islands with the exception of Kandavu, was completed and published in 1917. The Lands Department is following the progressive course of breaking down the Primary Triangulation as opportunity offers. During the year, four of these "minor trigs" were established in Vanua Levu, Mathuata Province.

The total number of minor stations fixed by officers of the Department is 199 in the larger main island (Viti Levu) and 90 in the smaller (Vanua Levu).

Traverses.—Five and one-half miles of standard traverse were measured in Rewa Province. It was found that Indians and natives

were removing the old marks; a new type of concrete slab, 15 × 15 × 3 inches, containing a 1 inch galvanised pipe, 18 inches long, was therefore used on this traverse.

Tribal Boundaries.—The survey of the *Matangali* boundaries was begun in 1912. During 1926 field work was carried on in the Provinces of Rewa and Mathuata, 35,812 acres in 510 lots being covered at a cost of £2,242, i.e., 15d. per acre or 85s. per *matangali*. The Commissioner points out that, as the staff employed consisted of four new men, progress was slow and was hampered by the relative smallness of the tribal lots and the density of the undergrowth. The vegetation will be a constant deterrent, except in the *Talasinga* country on the west; in the uplands of the east the difficulty of the upper will replace that of the undergrowth and there appears little doubt that the *Veikau* country, though not generally unhealthy, will offer the greatest impediments to survey, particularly where, on ground whose minor features are so prolific as to be incapable of enumeration, boundaries are somewhat dubious.

Miscellaneous Surveys.—The miscellaneous work included the following surveys: 7 Crown Leases, 41 Native Leases, Scenic Reserve, Catchment Area at Lautoka, Dairy Scheme, School Site, Cemetery.

Land Registration.—The Department deals with a large volume of work involving the leasing and alienation of land and the examination of the surveys consequent thereon. Information, largely statistical, with reference to this Branch is admirably set forth in the report.

Irregularities were met in 1924 by amended survey regulations whereby power was acquired to cancel approval of leases not executed within six months. 581 plans of surveys by 6 Licensed Surveyors, covering 7,878 acres, were examined, plotted on the standard sheets, and passed for issue of title. Some information as to the number rejected for technical reasons on first examination would be of interest.

The addition of a Forestry Officer would facilitate some of the work of the Department, since the Colony is somewhat ignorant of its resources in timber and other woods.

Of the 4,532,620 acres (7,082 square miles) which the Colony is estimated to contain, 923,800 are alienated. Of this total 531,350 acres are freehold, 372,000 are native leaseholds and 20,400 are Crown leases.

Plans and Prints.—1,170 tracings were prepared, in the main for official use. The absence of zincographic printing prevented the Commissioner from illustrating his report by graphs. Since no such plant appears to exist in the Colony, and prints must frequently be demanded by various Departments who have to send their work abroad, it is a question if the Lands Department can

much longer continue to depend on the slow and expensive process of reproduction by hand; as mapping increases, power presses, with colour printing when required, become necessary equipment for a Survey Department. A start might easily be made with the inexpensive Vandyke process.

Gold Coast, 1925 and 1926.

Governor.—Brigadier-General Sir F. G. Guggisberg, K.C.M.G., D.S.O.

Surveyor-General.—Lieutenant-Colonel R. H. Rowe, D.S.O., M.C., 1st April, 1925, to 26th October, 1926. Mr. J. Glendinning, B.Sc., 27th October, 1926, to date.

Deputy Surveyor-General.—Mr. J. Glendinning, 1st April, 1925, to 26th October, 1926. Mr. W. F. Mindham, appointed but had not taken up his duties at the end of the year.

Topographical Work.—By June, when the field season for topography closes, it was estimated that the state of the topographical map would be as follows :—

	Sq. Miles.
Surveyed in the Northern Territories before the war	10,000
Surveyed between 1920 and 1927	45,600
Still unsurveyed	36,400
Approximate area of Colony	92,000

The policy of setting aside a definite sum of money for the production of a topographical map has fully justified itself. The rapid development of the Gold Coast in the past seven years has been greatly assisted by this survey. Anyone who is doubtful whether the topographical survey repays its cost as a means of development should compare the alignment of the old Sekondi-Kumasi railway, located without a map, with its new alignment and with that of the Central Province Railway where the preliminary alignment was chosen from the one-inch map. The additional cost of working the old railway on a bad alignment, and the cost of the deviations found necessary later, exceed many times the cost of the whole topographical map of the Colony.

The special vote of 1920 for the topographical survey has now been exhausted and the original programme completed. The special party of Royal Engineer officers and non-commissioned officers are not, then, to be further employed on the production of the topographical map, which will be carried on by a permanent staff of two Europeans and ten Africans. The part of the country where intensive development is going on has been mapped, but some of

the earlier sheets now require revision, and it does not seem likely that further progress will be rapid.

The following figures of the cost of topographical work are instructive as showing the reduction in costs as the surveyors got better practised in the methods required in a forest-clad country and as more of the work could be taken over by trained African Surveyors.

	£	s.	d.
(1) Average cost of a Field Sheet in 1921	1,190	0	0
(2) Average cost of a Field Sheet in 1926	592	0	0
(3) Average cost per sq. mile in 1921	4	2	2
(4) Average cost per sq. mile in 1926	1	16	2
(5) Cost of one Field Sheet surveyed by one European Surveyor with planetable in 1926	340	0	0
(6) Cost of Survey of One Standard Sheet by African Surveyors on 1/125,000 scale in 1925	703	0	0
(7) Cost of Survey of one Standard Sheet by African Surveyors on 1/125,000 scale in 1925 per sq. mile	0	12	0

The above figures include field costs and purchase of stores, but not the cost of framework or salaries during leave.

The Topographical Branch has also sent parties to carry out the surveys in connection with the Boundary Commissions delimiting eastern and western frontiers.

Cadastral Branch.—The most important work done during the two years was the continuation of the triangulation for the main framework of the Colony. The sum originally voted for the special control party became exhausted at the end of the financial year 1926-27, but a sum was voted for its continuance on a reduced scale in 1927-28. It is satisfactory to learn that a small permanent control section is to be added to the Department.

The work done by this section affords a good example of the value of setting aside a definite sum and of working to a definite programme. Until this policy was adopted the framework of the Colony was in a chaotic condition, the work being done whenever surveyors could be spared from the current work of the Department. Now as the result of four years' steady work by one party, the area inside the triangle Accra-Kumasi-Sekondi has been covered by a first-class control with the result that all surveys undertaken in that area can be properly located. It is to be hoped that the policy of keeping a small permanent party at work to extend this framework will be persevered with.

A complete record of the work done by this party will shortly be published by the Gold Coast Survey.

The following gives a brief record of the work done :—

No. of Primary Trig. Points observed	54
No. of Primary Trig. Points reconnoitred but not observed	4
No. of Secondary Points fixed	5
No. of Base Lines measured	2
Miles of Primary Traverse	147
Miles of Spirit Levels	167

Angular measurements were taken with a 6-inch micrometer theodolite by Cooke, Troughton and Simms, in most cases to heliographs. The longest line observed was 46 miles. The mean triangular misclosure was 1.66 seconds. All results were adjusted by the method of least squares.

The closure obtained on the base at Obuasi was as follows :—

Length of Obuasi base as measured ...	19,903.96 ft.	
Length of Obuasi base as computed from Akuse base	19,903.34 ft.	
Difference (roughly 1/30,000)	.62	
Azimuth observed at Obuasi	189° 34′ 43″. 0	
	189° 34′ 37″.54	
		5″.46

Costs.—	£	s.	d.
Measurement of base at Akuse. Length 4½ miles partly scrub, partly grass. Measured twice with invar tapes in catenary. Including all preparatory work	about 693	0	0
Measurement of base at Obuasi in forest measured as above	about 760	0	0
Average cost of trig. point, including reconnaissance, clearing, and observing	174	0	0
Cost per mile of primary traverse Apam-Oda-Ochereso (including levels) ...	30	3	8

The permanent cadastral branch carried out a full programme, consisting principally of town surveys and the lay-out of township sites.

It is the policy of the Department to encourage licensed surveyors and to leave all paying work as far as possible to them. At the same time the standard of the test to be passed before a licence is issued is very properly maintained at a reasonably high level.

The following figures give the approximate cost of certain classes of departmental work.

Traverses—

Along Roads, £6 to £11 per mile.
Medium Bush, £14 per mile.
Dense Bush and Scrub, £23 to £30 per mile.

Levels—

Along Roads, £1 10*s*. per mile.
Medium Bush, £2 10*s*. per mile.
Dense Bush and Scrub, £6 per mile.

Contouring, 15*s*. per acre on 1/1,250 scale.

Town Survey work—

Detail Survey, 20*s*. per acre.

These costs include all work actually done in the field and computations, but not plotting of plans and checking in the office. They include an addition of 20 per cent. to cover cost of supervision.

Accuracy.—For licensed surveyors no work with a closing error greater than 1/3,000 is accepted. Departmental traverses usually close to between 1/10,000 and 1/20,000.

The Wireless Framework Party.—The framework for the half-inch topographical map is now provided entirely by astronomical latitudes and wireless longitudes. This system is found to give sufficient accuracy for the control of the map in view of the methods of survey employed, and is very much cheaper than the former method of a network of theodolite traverses.

Observations have also been taken at a number of primary trig. points in order to determine the deflection of the vertical.

Observations to determine the magnetic variation were also taken by this section and a chart showing isogonals at 30-minute intervals for 1st January, 1927, has been published.

Much valuable information about the design and use of wireless receiving sets and of chronographs has been gained. Space does not permit of a summary; those interested should consult the full report of the Gold Coast Survey Department.

The Survey School.—The excellent work done by the school since its opening in 1921 is now bearing fruit in the reduction of costs, as the trained African Surveyors take up their duties in the field.

A new building to accommodate 50 pupils is being built at Accra, and the courses and conditions of entry are being revised in view of the opening of the college at Achimota, which is expected to provide a more educated type of candidate.

Reproduction.—This branch is now reproducing all the maps and plans required for local use. A large amount of work has been done for other Departments and for Sierra Leone. The output has been increasing so rapidly that it has been necessary to increase the accommodation and instal an additional flatbed machine.

The average cost of reproducing various classes of map are given below :—

	£
One-inch field sheet (area about 290 square miles), drawing, reproducing in five colours, and printing 300 copies	40
Half-inch standard sheet (area about 1,160 square miles), drawing, reproducing in five colours, and printing 600 copies	85
1/1,250 Cadastral Town Plan, drawing, reproducing in one colour, and printing 100 copies	20

Hong Kong, 1925 and 1926.

Governor.—Sir R. E. Stubbs, K.C.M.G.; Sir Cecil Clementi, K.C.M.G. (from 1st November, 1925).
Director of Public Works.—Mr. H. T. Creasy.
Superintendent of Surveys.—Mr. E. B. Reed.

Organisation, 1925.—Until the 31st December, 1925, the Crown Lands and Survey Offices were combined and included a staff of 14 European Surveyors, 7 Chinese Assistant Surveyors, 12 Chinese Apprentice Surveyors, and 2 Chinese Student Surveyors, under the direction of an officer designated the Superintendent of Crown Lands.

At the beginning of 1926 the Crown Lands and Survey Office was re-organized and made two separate sub-departments of the Public Works Department. The whole of the survey work of the Colony is now under the control of a Superintendent of Surveys.

Organisation, 1926.—The Survey Office is now a separate sub-division of the Public Works Department and carries out the whole of the survey work of the Colony.

Staff.—

In the Field.

1925.	1926.
11 European Surveyors.	11 European Surveyors.
8 Chinese Surveyors.	11 Chinese Surveyors.
17 Apprentice and Student Surveyors.	13 Apprentice and Student Surveyors.

In the Office.

1 European Draughtsman.	1 European Chief Draughtsman
12 Chinese Draughtsmen.	14 Chinese Draughtsmen.
1 European Clerk.	1 European Clerk.
6 Chinese Clerks.	6 Chinese Clerks.
3 Chinese Computers.	3 Computers.
There are also: 89 Survey Coolies.	85 Survey Coolies.

Cost—exclusive of office accommodation.

	1925.		1926.
	$		$
Salaries	185,531		110,724
Conveyance Allowances	13,000		7,891
Coolies' Wages ...	11,614		13,172
Rent Allowances ...	10,925		8,039
Survey Expenses, Transport ...	7,230		6,313
Total for 1925	228,300	Total for 1926	146,139
Total for 1924	208,487	Total for 1925 ...	228,300

Training of Chinese Surveyors.—The School started in 1922 for this purpose is stated to be productive of good results. No figures are given to indicate the number of students trained or the proportion of them that prove subsequently to be of value to the Department.

Chinese Surveyors, 1926.—The scheme for training Chinese Surveyors is, temporarily, in abeyance owing to lack of European staff, but it is interesting to learn that they became efficient minor control observers and cadastral field hands.

Control Surveys.—The triangulation of Hong Kong would seem to be a patchwork of portions observed at different epochs and more or less independent of each other. In 1927 two small additions to this control were made, and are referred to as " very good " and " sufficiently accurate " to check certain traverses respectively. No details of observation or closing error are given.

The Survey Department provided lists of positions on which to base a new military survey. These lists gave both geographical and plane rectangular co-ordinates. In many cases, however, these alternative values did not agree.

In spite, therefore, of evidence of careful re-observation in places, the trigonometrical control is evidently far from perfect, and may fail to provide sufficient accuracy for so important an area and so dense a population. The area concerned is small. Fresh observation and consistent adjustment can in no case be a difficult task. The first step should be to review all the field measures and to adjust the good material, leaving fresh extension or perhaps some necessary re-observation to be carried out subsequently.

In the same way the traverse control is continually referred to, but there is no mention of closing rule or of individual error. It is impossible, in fact, to gauge the work from the style of report which is submitted.

Large Scale Surveys in 1925, 1926.—Under various headings, which appear to consist in the main of engineering plans, for road and drainage lay-out, and of cadastral plans, for general municipal

use and revenue assessment, some 1,150 acres in 1925 and 2,000 odd acres in 1926 have been finished. The scale is not always stated. It appears to be generally 1/600 in the field, reduced eventually to 1/2,400 for cartography.

Topographical Survey.—The new 1/25,000 map in 20 sheets has been begun by the War Office. The control of this map is provided by the triangulation which has already been described and which was added to in the field, and by a large number of instrumentally-measured spot heights.

There is no indication in either report of any direct return, as, for example, registration fees, earned in respect of the survey operations described, and, as before, the reports contain no technical or statistical details whereby the accuracy, efficiency, and economy of the work may be judged. They are, therefore, of little value as indications of the present state of the Survey.

Jamaica, 1925.

Governor.—Brigadier-General Sir S. H. Wilson, K.C.M.G., K.B.E., C.B.

Surveyor-General.—Mr. W. Anthony Baker.

Expenditure and Revenue.—

Heading.	*Expenditure.*			*Revenue.*
	Personal Emoluments.	*Other Charges.*	*Total.*	
	£	£	£	£
Surveys	196	193	389	—
Land Records	4,114	573	4,687	6,927
Crown Land Development	17	16	33	3
Cutting Timber	14		14	316
Totals	£4,341	£782	£5,123	£7,246

The expenditure shows a decrease of £1,000 on the previous year.

Staff.—This consists of the Surveyor-General and an Assistant, two Surveyors, one Draughtsman, and five Clerks—10 members in all.

Surveys.—Since one member only of the Staff was available for fieldwork, and he for three months only, Licensed Surveyors have been employed on Government property. These surveys included some closed tertiary traverses, 44½ miles in all, executed at a daily rate of about ½ mile, showing errors of closure from 1/300 to 1/6,450 and costing nearly £9 per mile.

Land Registration, etc.—The nature of the work of the Department may be gathered from the expenditure and revenue tabled above. The following is a summary of the work passing through the Department.

	No.	*Average.*	*Amount.*
Applications for land received	64	443	
Applications satisfied	39	393	
Titles issued on payment by instalment... ...	118	1,135	
,, ,, for Cash payment	13	100	
Purchase money received	—	—	£2,682
Town (35) and other lots (69) leased	104	—	
Predial tenancies	3,845	—	
Rents collected during year	—	—	£3,738
Notifications under Forfeiture Law	248	10,301	
Interlocutory judgments obtained	118	7,284	
Holdings advertised for forfeiture	2,371	9,870	
Holdings freed on payment of taxes	985	4,881	
Taxes and costs recovered (net)	—	—	£2,440
Holdings (forfeitable)	1,386	4,939	
Interlocutory judgments reached	1,245	3,067	
Plans examined and reported	529	—	
Plans re-submitted, examined and reported ...	378	—	
Diagrams prepared for registration of title. { Crown / Private }	115 / 368	—	£373

84 per cent. of the plans submitted by Licensed Surveyors were rejected in 1924; this year the percentage fell to 71, which is still a high percentage, the more so since it is admitted that the checking of these plans is defective.

680 notices to quit and 285 levy warrants were served on predial tenants, of whom 25 per cent. thus definitely fail to respond to their obligations.

The proceedings under the Forfeiture Law refer to a period of five years.

Jamaica, 1926.

Governor.—Sir R. E. Stubbs, K.C.M.G.
Surveyor-General.—Mr. W. Anthony Baker.

Expenditure and Revenue.—The several disbursements and returns are neatly summarised in the Report.

	Expenditure.			
Heading.	*Personal Emoluments.*	*Other Charges.*	*Total.*	*Revenue.*
	£	£	£	£
Surveys	40	60	100	—
Lands Records	4,297	726	5,023	7,990
Crown Land	—	—	—	—
Development	18	62	80	7
Cutting Timber	17	—	17	341
Totals	4,372	848	5,220	8,338

These figures confirm the statement that the work is mainly that of a Land Department, not of a Survey Office. In this case the title of Surveyor-General is somewhat of a misnomer. The £100 spent on surveys represents the work of one surveyor for three weeks, supplemented apparently by some work put out on

contract. The surveys included a few traverses, extending to 14 miles at a rate of ½ mile per diem and at an average cost of £8 6*s*. per mile. Closing errors varied from 1/420 to 1/1,953, indicating tertiary work.

The following table summarises the Land Work of the year :—

	No.	*Acreage.*	*Amount.*
Applications for land received	24	120	
Applications satisfied	6	64	
Titles issued on payment by instalment... ...	226	1,986	
„ „ for cash payment	12	19	
Purchase money received	—	—	£2,495
Town (31) and other lots (70) leased	101	—	
Predial tenancies	3,980	—	
Rents collected during year	—	—	£4,169
Notifications under Forfeiture Law	247	10,294	
Interlocutory judgments obtained	117	7,277	
Holdings advertised for forfeiture	2,693	10,565	
Holdings freed on payment of taxes	1,051	5,065	
Holdings forfeitable	1,642	5,500	
Final judgments on remaining forfeits	850	1,912	
Interloctury ditto	395	1,155	
Plans checked (increase over 1922, 120 %) ...	1,409	—	
„ examined and reported	915	—	
„ re-submitted...	494	—	
Diagrams prepared for registration of title. { Crown	209	—	} £477
{ Private	552	—	}
Plans copied (increase over 1922, 100 %) ...	1,747	—	
Blue Mountain Forest Reserve	—	28,600	
Ditto, already in hands of Crown	—	22,250	
Spring Garden Land Settlement	44	108	

The proceedings for forfeiture listed above extend over six years, the statistics given bringing the situation up to date.

Of the plans submitted for registration of title, 54 per cent. were rejected on first submission, somewhat of an improvement over the record of the previous two years.

Land settlement is not making rapid progress.

Nigeria, 1925 and 1926.

(*Period from 1st April, 1925, to 31st December, 1926.*)

Governor.—Sir Hugh C. Clifford, G.C.M.G., G.B.E.; Sir Graeme Thomson, G.C.M.G., K.C.B. (from November, 1925).

Surveyor-General.—Mr. A. Cleminson, 31st March, 1925, to 14th December, 1925; Captain T. J. Waters, R.E., 15th December, 1925, to 31st December, 1926.

Deputy Surveyor-General.—Captain T. J. Waters, R.E., 31st March, 1925, to 14th December, 1925; Captain J. Calder Wood, M.C., December, 1926.

Assistant Surveyor-General.—Captain T. H. Galbraith, M.C.

Organisation.—The Department is organised as follows :—

(*a*) Headquarters.

(*b*) Trigonometrical Branch, under Deputy Surveyor-General.

(*c*) Topographical Branch, under Deputy Surveyor-General.

(*d*) Cadastral Branch, Southern Provinces, under an Assistant Surveyor-General.

(*e*) Cadastral Branch, Northern Provinces, under an Assistant Surveyor-General.

The Headquarter Office deals with the general administration of the Department. The Trigonometrical and Topographical Branches, Computation Section, Meteorological Office, Wireless Time Signal Station, Survey School, and Reproduction Section are directly under Headquarter control.

(b) *Trigonometrical Branch.*—After the war the state of the main framework of the Colony was as follows: There were four patches of isolated triangulation near Abeokuta, Bauchi, Kano, and Udi.

Each of these had been surveyed for a specific purpose and the order of accuracy was only sufficient to achieve that purpose. They were consequently of no value as parts of a main framework of the Colony. It was realised that this state of things was unsatisfactory and that, so long as the Department was forced to employ all its personnel on urgent surveys of a local nature, matters would only grow worse.

It was accordingly decided, after consultation with the Colonial Survey Committee, to start a main framework for the Colony on a definite programme, with surveyors who were to be allotted definitely to that task. A start was to be made by reobserving the existing triangulation and then connecting it together. Eventually it was to be extended to form a "grid" at about $1\frac{1}{2}^{\circ}$ interval. It was estimated that this programme could be carried out by three observers in 10 years.

A rectangle of this grid has now been completed joining Kano, Jos, Minna, and Zaria. By the end of the 1926-27 season it was hoped that this rectangle would be connected to Udi and Abeokuta. The fieldwork during the period under review was carried out by two groups.

Group No. 1, with one European, who was responsible for reconnaissance, beaconing, and observation, carried the triangulation across from Minna to Kano, where a closure was made on the base.

The mis-closure with astronomical observations was only a fraction of a second in latitude and longitude and about 12 seconds in azimuth.

The statistical results of this triangulation show:—

Main stations occupied, 50.

Area covered, 6,950 square miles.

Average triangular error, 1.99″.
Cost per square mile, 3*s*. 8*d*.

Group No. II, also with one European, was only in the field during 1926. This group started northwards from Udi and was much hampered by the difficult nature of the country.

The summary results were :—

Main stations occupied, 11.
Area covered, 320 square miles.
Average triangular error, 2.14″.
Additional points reconnoitred and beaconed, 10.
Area reconnoitred in advance, 115 square miles.

The computation of final co-ordinates is being delayed until the triangulation has been joined to Lagos and certain other closures are made. It is hoped that this will be completed in 1927-28.

The report contains three pages devoted to the listing of provisional geographical co-ordinates of major and minor vertices of three trigonometrical chains.

(c) *Topographical Branch*.—Owing to an overplus of work at the minesfield this Branch was closed for three months in 1925. Six sheets on the scale 1/125,000 were completed during the period. The report contains the Okigwi Sheet, printed in five colours. This shows the drainage of the district very clearly. The lettering, naturally enough, is somewhat unfinished, though seldom lacking clarity. The register is well preserved. The work, done under tropical conditions, reflects credit on producer and reproducer alike.

A party organised for the Minna gold areas met with less success. It is obvious that prolonged training and severely selective tests are necessary to secure northern natives competent to perform topographical duties.

(d) *Cadastral Branch, Southern Provinces*.—The staff in the Southern Provinces is organised in three Groups, centred on Lagos, Aba, and Warri. For survey purposes " towns " are distinguished from " country lands." " Country " surveys are generally not contiguous and have to be referred provisionally to a datum obtained by traverse from adjacent properties, with a check azimuth; or, rarely nowadays, to a datum partially fixed by an observed latitude and azimuth. These " country " surveys, conducted by Africans, are inexpensive and apparently considered sufficiently good to be incorporated by adjustment into a cadastral framework as soon as the Colony is in a position to undertake this onerous duty.

The laborious cadastral revision of Lagos Island for the Lagos Town Council was completed during the year on the scale of 20 feet/1 inch for reduction to 88 feet/1 inch or 5 feet to 1 mile. An outbreak of plague necessitated a further survey of 700 acres at Yaba, where properties had to be acquired.

The cost of cadastral work varied from about 20*s*. per man-power day in Benin to about 30*s*. in Aba, the expense for revision being 13*s*. 4*d*., for Forest Reserves, 22*s*. 6*d*., and for Lay-outs, 30*s*. 8*d*. per man-power day; these figures include an additional 20 per cent. for overhead charges. No doubt future statistics will show the output against the same unit of work.

(e) *Cadastral Survey, Northern Provinces.*—This Branch is organised in two Divisions: (1) Minesfield, (2) Kano.

(1) *Minesfield Division.*—At the end of 1925 the outstanding applications for mining and exclusive prospecting leases had increased by 30 per cent. over the beginning of the year. A Royal Engineer party under Captain B. T. Godfrey-Fausset, M.C., was therefore sent out to cope with this rapidly-growing demand. From mid-October to the end of the year the plans of 31 mining and six prospecting leases had been forwarded to Kaduna through the Assistant-Director of Surveys at Jos.

(2) *Kano Division.*—The principal duty of this Division is the Kano Revenue Survey, established in 1918 to supply the Kano Administration with accurate statements and plans as to the location, content, and soil-grading of farms in the Emirate. Its work extends to other Emirates, such as Katsina, where such work is in progress on a much smaller scale. The revenue is shared equally by the Government and the local Administration, and, as the tax varies from 6*d*. up to 3*s*. per acre, according to the land valuation, the assessment brings in large sums which, with the progress of survey, rapidly increase. The Kano Division has a staff of 40 (against eight in 1918) and an output of 60,000 acres per annum.

The cost of the Revenue Survey, excluding topography and framework, works out at 1*s*. per acre. The method is that of compass traverse with chain; the error of closure is put at 1/400 in linear measures; the work, which is executed by native surveyors under European supervision, is plotted on sheets at the scale of 1/2,500; and the records are bilingual, typed in Roman and Arabic script.

General.—The Sokoto Irrigation Survey, mainly contouring, was completed, but no figures are given. The Lithographic Section continues to function at Kano, awaiting removal to Lagos when the necessary buildings are completed. Railway surveys occupied some little time and there has been miscellaneous work in the Northern Provinces, indicative of general activity.

(f) *General Remarks.*—During the year it was decided to adopt the Clarke (1880) spheroid as the standard figure for the Colony, with the Clarke ratio of the Metre : Foot. In consultation with the Geographical Section, General Staff, of the War Office, it was

also decided to adopt the Transverse Mercator projection. To this end the Colony was divided into three meridional belts; to keep the overlap to a minimum the crossings of the bounding grid and graticule were placed on the mid-Colony parallel of 9° N.; a scale factor of 1/4,000 was introduced in each belt; and a virtual origin was chosen as common to all three belts.

There is little doubt that the Survey of Nigeria has already recovered from the disorganisation due to the war.

Northern Rhodesia, 1925 and 1926.

Governor.—Sir Herbert James Stanley, K.C.M.G.
Director of Surveys.—Mr. W. G. Fairweather.
Examiner of Diagrams and Surveys.—Mr. L. W. G. Eccles, M.C.

Staff.—

Director	1	
Examiner of Diagrams and Surveys	1	
Assistant Surveyors	5	(1 place unfilled).
Junior Assistant Surveyors ...	2	(1 added in 1926).
Clerk	1	(added in 1926).
Native Clerk	1	
Chain Boys	4	
Messenger	1	

The unfortunate death of Mr. F. P. Ivey in December, 1925, and the appointment of Mr. Godwin Austin to be Director of Roads, leaves the survey weakened by the loss of two keen and able men whose places have not yet been filled. Three more assistant surveyors have been budgeted for but not yet appointed.

Boundary Commission.—The Zambesi-Congo watershed boundary between Northern Rhodesia and the Congo was in course of demarcation just before the war. Since then, further important mineral discoveries have been made in its neighbourhood and a considerable amount of development has taken place. It was considered necessary to carry out a more detailed demarcation of the sections between the marks already agreed on. A new joint Boundary Commission is therefore now at work (1927). Before it was convened the Director of Surveys sent Messrs. Godwin Austin and Turner to perambulate and report on pillars 1 to 12, a duty which was efficiently and thoroughly completed in 1925.

Trigonometrical Work.—Plans for some much needed triangulation to connect previous and scattered patches have been afoot for some time. Unfortunately the pressure of routine has made it impossible to carry out this project although some reconnaissance has been completed.

Topographical Survey.—Systematic Topographical Surveying has not yet been begun. That is no matter of wonder in view of the respective sizes of the Colony and of the survey staff.

Some of the surveys mentioned are useful additions to cartography, but scattered and independent surveys will never take the place of a consistent control and topography. There has been a good deal of air photography in the Anglo-Belgian boundary region which, with adequate horizontal and vertical control, may be a good beginning in that area.

Special Work.—A survey of the Katambora-Livingstone area has occupied several man-months. Some reconnaissance, accompanied by 10 miles of levelling, was carried out in connection with an Agricultural and Veterinary Experimental Station. Certain native reserve areas in North-Western districts have been delimited.

Map Compilation and Reproduction.—At the stage of development in which Northern Rhodesia now is there must be a continual and growing demand for maps and sketches of all sorts. Thus the reports instance the 1/M, the 4/M and the 1/4 M maps compiled in the Survey Office and either sun-printed or sent to England for reproduction. Surveys are beginning, some with conspicuous success, to undertake both drawing and printing. For numbers exceeding (say) 50, sun-printing is uneconomical and inefficient. A Vandyke outfit and both hand-press and machine are advocated.

The 1/M map of Northern Rhodesia is to be recompiled. Seven new sheets of the 4/M have been compiled and a small 1/4M has been compiled and is being printed. In this connection it is stated that the only available room for fair drawing and compilation is 20′ × 20′, which has to accommodate seven people. If the work is to be performed properly, each draughtsman must face his own window space with at least 8′ × 6′ for his own immediate labours and have additional room for the material and records he is using.

Cadastral Work.—In the two years under review some 380 thousand acres have been dealt with and over £7,000 has been earned in survey fees. No purpose will be served by recapitulating further the valuable and careful statistical record furnished by the reports.

General.—The meteorological work of the Colony hitherto carried out entirely by the Survey Department has been helped on by the appointment of a full-time observer for the local observatory. The Director of Surveys continues to be responsible however for the collection and recording of the work of outstations as well as of final compilation and the supervision of the local observatory.

The last two years have been a period of particular strain and the Department is barely keeping pace with an ever-increasing demand for its services.

Nyasaland, 1925-1927.

Governor.—Sir C. C. Bowring, K.C.M.G., K.B.E.

Lands Officer.—Mr. J. E. Alexander.

Staff.—In the last year a draughtsman seems to have been replaced by a native tracer.

The cost and work of the Department are so nearly the same as in the last Committee's report that no further details need be given. A limited amount of topographical survey is mentioned, but, if no trigonometrical control has been done, it is not likely to be of good or permanent character.

The report gives no details of the tasks which face the Department, of the methods in use, or of cadastral and financial statistics.

Palestine, 1925-26 and 1926-27.

INCLUDING NOTE ON THE TECHNICAL SYSTEM OF THE SURVEY OF PALESTINE, JANUARY, 1927.

High Commissioner, 1925—Rt. Hon. Sir Herbert L. Samuel, P.C., G.B.E.; 1926—Field-Marshal the Rt. Hon. Lord Plumer, G.C.B., G.C.M.G., G.C.V.O., G.B.E.; 1927—Field-Marshal the Rt. Hon. Lord Plumer, G.C.B., G.C.M.G., G.C.V.O., G.B.E.

Director of Surveys.—Lieut.-Colonel C. H. Ley, R.E. (Ret.).

NOTE ON THE TECHNICAL SYSTEM.

The main and ultimate object of the survey is given as the economical production of large-scale cadastral plans correctly showing each individual parcel of land as registered. But individual parcels are not yet registered and are largely undemarcated. The immediate objective then has been the production of large-scale maps in advance of settlement, to show, in plan, a sufficient number of points established on the ground to facilitate future demarcation. The ultimate (or fifth order) control is obtained on the planetable and, in the course of fixing this fifth order, topographical detail (such as *wadis*, etc.) is added. The plans are therefore called " topo-cadastral."

The control has been framed to give an ultimate fractional error of the order of 1/1,000. The principal triangulation was extended from a base at Imara (south of Gaza). This base was measured originally by the survey of Palestine and later by the survey of Egypt. The probable error of this last measurement is given at the optimistic figure of 1/2M. Probably the standardisation error of the original reference tape exceeds this figure.

A check base at Samakh (near the Syrian frontier) gives a poor linear check of 1/1,200 with the value carried through the triangulation from the Egyptian measurement of the Imara base. The original adjustment of the Principal Triangulation was, however,

rather piecemeal. The triangulation had in fact to be made use of as it grew. A new and more rigorous adjustment, in two blocks, is to be undertaken, however, and both bases are to be used. The comparatively small area to be covered has had considerable influence on methods and processes. The principal triangulation has the unusually short average side of 13 kilometres. A second order in addition would be quite unnecessary; indeed the Palestine principal is intermediate in character between first and second orders. The next step is then a third order, followed by a fourth order, and finally completed by a graphic fifth order.

The errors of this network are given as under :—

Portion of Network.	*Average Triangular Error.*	*Average Length of a Side.*	*Average Scale-error.*
Principal	± 1·4″	13·20 KM.	± 1/70,000
3rd Order	± 4·9″	4·20 KM.	± 1/30,000*
4th Order	± 10·0″	0·89 KM.	± 1/10,000*
Graphic	—	0·45 KM.	± 1/1,500*

* Includes errors transmitted from the higher order network.

It will be seen that third order sides are about 1/3 of the length of principal sides, fourth order about 1/5 of third order sides. Observation was regulated accordingly and consisted of :—

Principal, 8-inch theodolite, 6 arcs. (9 in base extension).
Third order, 5-inch theodolite, 4 arcs.
Fourth order, 5-inch theodolite, 2 arcs.

(*Note.*—Each " arc " consisting of a balanced set.)

The adjustment of the principal triangulation has already been dealt with. The third order is adjusted by working two independent " chains " between each pair of principal points, fitting scale and azimuth to them, and values are meaned between the two chains. If there are any points left inside a triangle of adjusted chains values for them are meaned from all sides. This simple co-ordinate adjustment is perfectly sound and seems to give good results.

The fourth order is adjusted in much the same way except that a single (and not a double) chain is adjusted between each pair of points of the higher order.

The various " controls " described above give on the average 5½ points for each 1/2,500 sheet. This is not enough. The final, or fifth order, then, carried out graphically on the planetable fixes, by intersection, village boundaries, cultivation blocks, and landmarks at suitable distances.

Naturally each planetable " fixing " has a " plotting " error of about ½ a metre (on the ground). It is then laid down that intersected points must be at least 350 metres apart (so as to avoid outside errors of 1/500).

Tests on these points seem to confirm a general order of error of 1/1,500, which is good enough.

In close areas this graphic fifth order is replaced by traverses which tend to show differences between lengths as taped and as computed from co-ordinates of about 1/1,000.

The datum latitude, confirmed by observations at three points, differs from Egyptian values (as used during the war) by 1.4 seconds of arc. The datum longitude is, ultimately, referred to a value obtained by the Transit of Venus Expedition of 1874. A dependable direct value might be fixed with but little trouble.

The first co-ordinate system was on Cassini's Projection based on a central meridian through Jerusalem. The greatest longitudinal distance from this central meridian is about 90 kilometres and the maximum errors involved would then be about 10 seconds in azimuth and 1/12,000 both of scale and of area. It is believed that a new orthomorphic projection is in view and that the present mixture of spheroids, due to the convenience of German and American survey tables, is to be abandoned in favour of the Clarke 1880 figure.

The field costs of the methods described above are a[illegible]nder :—

Section of Work.	*Average Cost £E. per sq. K.M.*	*Remarks.*
Principal Trig....	0·58	See note.
3rd Order Trig.	0·56	
4th Order Trig.	4·84	
1/2,500 *Topo-cadastral Mapping.*—		
Planetable (Open Lands)	10·00	Includes Landmarks.
Chain Survey (Close Areas)	77·00	Includes Examination.
Chain Survey (Very Close, requiring Traverse) ...	171·00	" "
1/500 *Close Town Plans*	913·00	" "

Note.—Includes base measurement, astronomical observations, reconnaissance, and cost of beacons.

The total cost of the 1/2,500 preliminary map in open village lands is therefore £E.16 per square kilometre, and in ordinary close areas £E.83 per square kilometre, on the average.

The 1925-26 and 1926-27 Reports.

The two reports of the Director of Surveys begin at a point when the principal triangulation, fully observed, is being readjusted.

Control.—104 and 109 third-order points, and 1,847 and 2,030 fourth-order points, were observed in 1925 and 1926 respectively, and many landmarks were fixed on the planetable.

Large Scale Surveys.—

Planetabling.—In 1925-26 80,000 dunams were completed on the 1/2,500 scale in the south of Palestine—(4 dunams = 1 acre). 103,000 dunams in the Jaffa Plain and 1,800 dunams in Cæsarea were also finished. The cost of this work was 1.25 *piastres* per dunam (or roughly one shilling per acre). 48,000 dunams of less valuable land were surveyed at 1/5,000 at a cost of 0.5 *piastres* per dunam (or fivepence per acre).

In 1926-27, 400,000 dunams and 49,000 dunams were surveyed on the 1/2,500 and 1/5,000 scales respectively at costs of 0.9 *piastres* and 0.15 *piastres* per dunam.

Chaining.—The survey of closer areas requires chaining. In 1925-26 74,000 dunams were so surveyed at a cost of 2.5 *piastres* per dunam (2*s*. 1*d*. per acre).

In 1926-27 a valuable orange garden area round Jaffa and Tel-Aviv consisting of 18,080 dunams was completed and plotted. The cost of this survey was 10.5 *piastres* per dunam, whilst that of some villages in south Palestine, containing 1,940 dunams, was 228 *piastres* per dunam (respectively 8*s*. 9*d*. and 190*s*. per acre).

1/500 plans in Guda itself, carried out in 1925, cost 83 *piastres* per dunam (roughly £3 per acre).

Cadastral Mapping.—Since 1922 considerable progress has been made with this work. The total is now 1,338,672 dunams (or 8,367 square miles).

Land Settlement and Miscellaneous.—In Beisan, lands are being surveyed, partitioned, and demarcated. The scales at which they are surveyed are 1/500, 1/1,000 and 1/2,000; the partitioning in conjunction with the Demarcation Commission is proceeding slowly, and about half the area has been completed, but how large that area is, is not stated.

Check Survey on the planetable of the Northern Boundary (with Syria) was carried out in the spring of 1926. Permanent demarcation was finished with the co-operation of French Authorities from Ras-el-Nakura to Samakh.

A map of Jaffa, covering 54 square kilometres, was made from air photographs controlled by minor triangulation and is being reproduced in Egypt.

A map of Jerusalem at the large scale of 1/2,000 in 46 sheets has been printed and issued.

Recapitulation.

To recapitulate then. The principal triangulation, completed in the field, is being readjusted. The third order is about half-finished, and the fourth order about a quarter-finished, but the coastal plain is completely controlled. The area finally completed by chain or planetable is about one-eighth of Palestine but already includes the most important areas. The standard of accuracy is adequate for the purpose and the costs are remarkably low. There is not enough information on land registry in these reports to afford much clue as to the real position of land tenure, nor are details of staff or of revenue and expenditure available.

Sierra Leone, 1925.

Governor.—Sir A. R. Slater, K.C.M.G., C.B.E.

Inspector-General of Surveys.—Lieut.-Colonel R. H. Rowe, D.S.O., M.C.

During 1925 it was decided to form a new Survey Department with the immediate objects of completing a large-scale cadastral survey of Freetown, the rapid topographic survey of the Protectorate on a scale of 1/62,500, and the establishment of a Survey School for the training of African Surveyors.

Topographical Work.—The personnel consists of Royal Engineer officers with African Surveyors lent by the Gold Coast Survey and is organised in five topographical field camps, one levelling camp, and one framework camp.

The Horizontal framework is being provided by astronomical latitudes and wireless longitudes on the system found successful in the Gold Coast.

The Vertical framework is being carried out by levelling based on the value for mean sea-level found by H.M.S. "Endeavour" in 1923. The closing error on a surround of 130 miles was 2.13 feet.

The work completed in about three months is:—

130 miles instrumental levels;
95 miles compass traverse;
6 points fixed by astronomical and wireless methods.

Cadastral Work.—The town survey of Freetown was begun in 1913 and closed down during the war. The original Survey was on a scale of 1/2,500. Experience on the Gold Coast has shown that 1/1,250 is a more useful scale. The work was therefore restarted, but this involved the re-observing of the old triangulation which was not accurate enough to control work at the larger scale. The surveyors, both European and African, were lent by the Gold Coast.

A check was made on a side of the topographical triangulation of the Colony carried out 20 years ago by Captain Pearson, and it was decided that that work is sufficiently accurate to be used for control of surveys in the Colony. When, however, a framework is started for the whole Protectorate it will be necessary to start afresh by measuring a new base.

It is surprising that in the last 20 years no use has been made of Captain Pearson's triangulation to control such cadastral surveys as have been made in the Colony.

Survey School.—The Colony is fortunate in having the old barracks of the West India regiment available for use as a Survey School. The type of candidate who presented himself at the first examination held was, however, thoroughly unsatisfactory. The

educational standard is at present apparently very low. The School, however, started work on 4th January, 1926.

General.—Sierra Leone is to be congratulated on the sound lines on which the Survey Department has started work.

Sierra Leone, 1926.

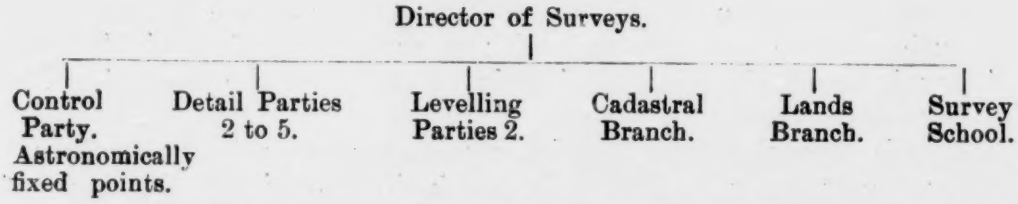
Governor.—Sir A. R. Slater, K.C.M.G., C.B.E.
Director of Surveys.—Major J. Dare, M.C.

Staff.

	Period January to June.	October to December.
European—		
General—		
Director	1	1
Survey Officers	5	3
Cadastral—		
Civil Surveyor	1	1
Non-commissioned Officers of the Survey Companies, Royal Engineers	2	2
Lands Officer	1	1
Survey Instructor	1	1
African—		
Topographical—		
Surveyors and Draughtsmen Surveyors (in three grades)... ...	9	8
Cadastral—		
Surveyors and Clerks (First, Second, and Juniors)	4	4
Lands—		
Surveyors and Clerks	4	4
Survey School	14 under training.	

Note.—Many changes occurred during the year and the figures given above are no more than an indication.

Organization.



Topographical Survey.—To those who know the state of the topographical mapping of Sierra Leone in 1925 the change is little short of miraculous. By the end of July, 1927, it was hoped to have completed the mapping of about a quarter of the territory of the Colony on the one-inch scale.

The Control—one of astronomically fixed points—cannot be considered ideal in so far as it will be of no value for cadastral mapping in the future. It is, however, ample for topographical

purposes, and is being employed more and more in French and Italian Colonies as well as in our own. The actual methods employed are interesting but call for no special comment. We have nowhere reached finality yet, either in the choice of astronomical method or in the design and use of wireless sets. Thirty-three points were fixed, computed and beaconed. Azimuths and magnetic elements were measured in each case.

The vertical control rests upon existing railway levels. 430 miles of instrumental levelling has been run from them, at a cost of £1 2*s*. a mile, and with errors of the order of ¾ of an inch per mile. For minor heights aneroid barometers, Abney levels, and Indian clinometers have been used.

The detail survey appears to be mainly minor traverse work and the policy is that it shall cost not more than £2 a square mile. Names are written in the R.G.S. II System and the check upon them is ample to ensure proper care.

Finally the sheets (it is a pity to call them Field Sheets in the final map form) are sent to the Gold Coast for reproduction. Gold Coast drawing and reproduction are making great strides; names continue to improve and maps printed there are already a tribute to what can be done in training African staffs.

As regards the general policy, it is not clear that a half-inch map would not serve the purpose. Were planetabling to be possible and were the staff sufficiently trained a considerable sum might be saved in that way. Where the survey is mainly instrumental, however, there is little to be gained in the smaller scale. A sample sheet enclosed in the report suggests open rolling country with great possibilities both for triangulation and the plane-table. Very few trees and no woods or forests are shown. Perhaps, however, they are omitted as being so general as to have escaped special mention.

Cadastral Survey.—The Cadastral branch was due to have finished the 1/1,250 Survey of Freetown in February, 1927. The Summary given below is an adequate explanation of method. On the conclusion of work in Freetown, outlying villages and suburbs are to be surveyed with a reduced staff, and the late Colonel Pearson's triangulation is to serve as the control. The transverse mercator is used.

Lands Branch.—The Lands branch, transferred to the Survey Department early in 1926, is much hampered by the lack of cadastral maps. A certain amount of business is reported.

Summary.

The following is a record of the work of 1926:—

Topographical Branch.—Thirty-three points fixed by astronomical observation and wireless time signals. Azimuths observed at each point and magnetic variation determined. All points fully beaconed. Computing done in the field.

Four hundred and thirty miles of instrumental levels completed,

Four thousand nine hundred and ninety miles of traverse (representing about 12 field sheets) completed, together with aneroid levels.

Six field sheets, on the scale of 1/62,500, sent to Accra for publication.

Cadastral Branch.—About two-thirds of the survey of Freetown, or about 1,400 acres, completed. Eighteen sheets, on the scale of 1/1,250 sent to Accra for publication.

Lands Branch.—

Thirteen new tenancies arranged.
Eight tenancy agreements prepared.
Ninety--three per cent. of rents for Crown lands collected.
Two claims under Public Lands Ordinance dealt with.
Eight claims in respect of other acquired lands dealt with.

Survey School.—Fourteen pupils trained to a sufficiently high standard as to admit of their being drafted into the field at the end of the year for elementary work and further instruction.

Tanganyika Territory, 1923-1926.

Governors.—Sir H. A. Byatt, K.C.M.G. (1923-24); Sir Donald C. Cameron, K.C.M.G., K.B.E. (from September, 1924).

Surveyor-General.—Mr. R. C. Allen, C.M.G. (1923-24); Mr. J. P. Tollard (1924-25); Mr. P. E. L. Gethin, A.F.C. (recently appointed).

Organisation.—The staff consisted in 1926 of the following :—

Director	1
Assistant Director	1
District Surveyors	4
Senior Staff Surveyor	1
Junior Staff Surveyors	12
Computers : Chief, 1 ; Assistants, 3	4
Draughtsmen : Chief, 1 ; Assistants, 3	4
Superintendent and Storekeeper	1
Total ...	28

Up to 1925 a joint department was charged with Lands, Surveys, and Mines. In 1925 the three duties were separated from each other and each was placed under its own Director. The Survey Department is charged with the following tasks :—

1. Triangulation and Topography.
2. Cadastral Surveys, inclusive of estates, public lands, townships, etc.
3. Mine Surveys.
4. Check and issue of plans, maps, etc.

The Department was faced, at the outset, with the collection, interpretation, analysis, and issue of a mass of German data, which were widely scattered over sub-offices, attached to old title-deeds, and often, unfortunately, defective.

The headquarter office deals with these old plans and records, indexing and distributing the information so gained.

The Surveyor-General at headquarters is assisted by a European drawing and computing staff numbering eight. An Office Superintendent and storekeeper also appears on the headquarter staff.

Surveyors in the field (District Surveyors) are posted to definite areas, and district offices have been opened at Tanga, Moshi, Mwanza, Bukoba, Tabora, and Morogoro. It is understood that junior staff surveyors are often employed in this capacity.

Triangulation (or Control).—During 1923 and 1924 an Anglo-Belgian Boundary Commission surveyed the boundary between Tanganyika Territory and the Belgian Congo. Messrs. H. P. Rowe and F. M. Ford of the Survey Department acted as British Commissioners and were responsible for the triangulation and topography. The actual triangulation was of a good " Commission " order, showing triangular errors of closure of the order of five seconds. The control chain, taken in conjunction with a Belgian triangulation from the Rhodesian arc to Albertville, joins the Rhodesian and Uganda arcs. The final adjustment (by figures), including angular and linear (or base) conditions, was left in the hands of the British and Belgian home authorities and has now been completed. Final positions, azimuths, and lengths will shortly be published. During the work of the Commission about 5,400 square miles were mapped on the planetable.

In 1925 the Survey Department was unable, owing to the pressure of other work, to undertake further control, but in 1926, in the Northern and Iringa provinces, some 1,000 square miles of triangulation were completed. In the latter case a surface-taped base (p.e. about 1/60,000), length roughly 7,000 feet, was measured on Kinuva Hill, whilst latitude and azimuth were obtained astronomically and longitude with the help of a wireless receiving set.

The triangular errors reached a maximum of 8 seconds, the average being of the order of 3 seconds.

Traverses are mentioned frequently throughout the reports and a closing rule of 1/2,000 is mentioned. A rule like this may often be either too lenient or too severe. For the framing of a suitable rule and in the question of forms which was raised in the 1926 Report it might be helpful to consult " Survey Computations," His Majesty's Stationery Office, 1927, price 8*s.* net.

For astronomical determination a portable wireless receiving apparatus has been fitted up. The receiver is a Marconi Standard R.P. 4 B set and has a half second make-and-break chronometer made by M. J. Mercer, of St. Albans, with special p.m. attachment arranged locally; such a set will be of the greatest value

to the Territory. Astronomically determined points may be useful as a framework either for the topography of outlying officials or for the control of air photo mosaics.

Topography.—In addition to the Boundary Commission topography mentioned above, some 5,500 square miles of planetable reconnaissance were carried out in 1925, and in 1926 about 1,200 square miles at a scale of 1/100,000. Some larger scale topography (1/2,500 and 1/10,000) was also completed in 1926 round Lubembe Bay.

In almost all Colonial areas the first maps are due largely to administrative officers. It is encouraging to see that in Tanganyika these latter are encouraged to forward their sketches and surveys to the Survey Office, where they are being included in a special 1/2,000,000 map.

Cadastral Surveys.—Township surveys are made at the scale of 1/500. In the years 1923-24 twenty-four township plans were made and in addition a considerable portion of Dar-es-Salaam was re-surveyed on this scale. In 1925 there was an equal activity. Tanga, Moshi, Arusha, Bukoba, Kigoma, Tabora, Dodoma, Morogoro, Iringa and other towns are all to be surveyed in a programme which it is hoped to terminate in 1928.

Roughly 50,000 acres of farmstead or estate surveys have been completed per annum at a cost of about 3*s.* per acre. The closing errors of the traverses are all below 1 part in 2,000. So far, work has been too urgent to allow of organizing settlement surveys in large blocks. Naturally considerable economy is to be looked for, when that measure is possible, and it is probable that triangulation might replace traverse in the more open districts. Cotton markets, ginnery sites, and trading centres are included under the same heading.

Mine Surveys.—There is an increasing call for surveys for mining leases.

Headquarters.—The clerical and accounting branch is supervised by the Office Superintendent, whilst drawing and computing branches are under their own senior officials.

In the drawing office there is an increasing pressure of work in the plotting, and tracing for reproduction, of the field surveys and also of the German plans and records which are continually appearing. Thus 4,000 photo prints were made in 1926. This style of reproduction is costly in time and very inefficient where large numbers are required. A Vandyke outfit has been imported but is not yet working properly.

The computing staff was used for a variety of purposes in 1925, but in 1926 was hard pressed to keep abreast of the checking and correction of the work sent in by districts.

Financial.—The cost of the survey is given for each year and averages about £25,000. A survey department is rarely self-supporting because the return, indirect in nature, lies in increased development and ease of administration.

General.—The Survey Department of Tanganyika has already given proof of energetic and capable surveying in the Ruanda-Urundi Commission. There is, however, so much to do in the development of the Territory that it is to be hoped that no further outside calls of this nature will be honoured. The impression given by the reports is of a new department settling down well to a task which will call for both energy and technical skill. The technical routine will require careful framing.

Trinidad and Tobago, 1925.

Governor ... ... Sir H. A. Byatt, K.C.M.G.
Crown Surveyor ... ... Mr. J. W. Macgillivray.

Staff.—A temporary computer-draughtsman and a pupil surveyor were attached to the Department.

Expenditure.—

	£
Salaries	4,630
Wages	2,246
Travelling Allowances	836
Miscellaneous	210
Total	£7,922

Triangulation.—Twenty-four new minor stations were fixed in St. Patrick County, with a mean triangular closure under 5 seconds.

Control Traverses.—Seventy-two miles of traverses, primary and secondary, were run along roads, rivers and boundaries as part of the Colony framework. These framework traverses are run between tertiary trigonometrical stations, fixed about 2 miles apart. The primary traverses are executed with a 300-link rustless steel chain, compared with standard steel tape, and aligned by a 6-inch Vernier theodolite. The permissible linear error is 1/3,000 and the average of the 16 traverses completed has been 1/6,450. On the secondary traverses the maximum error allowable is 1/1,500; of the 31 completed the average error has been 1/3,880. Each station is marked with a galvanised pipe and concrete pillars are built at every ¼ mile both on primary and secondary traverses.

Cadastral Work.—The field work of the year is set out in the following table :—

	Petition Surveys.		*Concession Surveys.*		*Reserves, Resumptions and Resurveys.*		*Controlling Traverses.*
	Chains.	Acres.	Chains.	Acres.	Chains.	Acres.	Chains.
Staff ...	... 11,098	1,799	—	—	1,965	785	5,649
Contract ...	... 7,712	1,294	4,440	5,095	761	367	97

Plans.—1,805 grant, lease, and survey plans of land transactions were made and 572 plans checked and certified under the Real Property Ordinance. Twelve new and 32 revised sectional maps were issued. Six of the new sheets on the scale 1/2,500 were drawn for reproduction by the Vandyke process.

Miscellaneous.—A table showing diurnal variation of magnetic declination in the Island was prepared for the use of surveyors, and solar observations were taken once a week to control the standard clock used for maintaining Island time.

Trinidad and Tobago, 1926.

Governor.—Sir H. A. Byatt, K.C.M.G.
Crown Surveyor.—Mr. J. W. Macgillivray.

Staff.—The computer-draughtsman retired and a pupil surveyor was attached to the Department.

Expenditure.—

	£
Personal Emoluments—	
Salaries	4,507
Wages	2,390
Other Charges—	
Travelling	759
Miscellaneous	249
Contingencies	15
Total	£7,920

Triangulation.—Six new minor trigonometrical stations were established in the counties of Victoria and St. Patrick; average error of triangular closure 10 seconds; maximum, 14 seconds. In future the maximum permissible error will be 10 seconds.

Controlling Surveys.—

	Petition Surveys.	*Concession Surveys.*	*Reserves Resumptions and Resurveys.*	*Controlling Traverses.*	*Petition Surveys.*	*Concession Surveys.*	*Reserves, &c.*
	Chains	Chains	Chains	Chains	Acres	Acres	Acres
Staff ...	11,936	—	2,102	4,159	1,604	—	1,208
Contract	8,498	709	2,077	22	1,177	—	998
Totals	20,434	709	4,179	4,181	2,781	—	2,206

Primary, secondary, and tertiary traverses showed average closures of 1/4,600, 1/2,900, and 1/1,700, respectively.

General—The work of the Department appears to be progressing on lines now soundly established. The cadastral plans are being plotted on the new series of 1/2,500 sheets of the Colony grid, and necessary detail can be transferred with ease to the topographical series on the scale of 1/50,000. The first pulls of the topographical sheets will be used as basic maps for the incorporation of cadastral detail and will thus form a small-scale cadastral series, for which the detail in general is taken from the older sectional maps on the scale of 1/9,504 and which will be reproduced by the Vandyke process.

Topographical Survey.—Officer-in-charge, Captain G. Latham, R.E.

The whole of Trinidad and Tobago has now been surveyed topographically, in greater part as a result of the work of a Colonial Survey Section.

The sheets of the series, numbering nine on a scale of 1/50,000, have been reproduced in colour by the Ordnance Survey.

Uganda, 1925 and 1926.

Governor —Sir W. F. Gowers, C.M.G.
Director of Surveys, Land Officer, and Commissioner of Mines.—Mr. Dyson Blair.
Deputy Director of Surveys.—Mr. H. B. Thomas.
Assistant Land Officer.—Mr. J. G. Strickland.
Conveyancer and Registrar of Titles.—Mr. D. L. G. Williams.

Staff.—

15 Surveyors.
1 Chief Draughtsman.
1 Computer.
1 Office Superintendent and Storekeeper.
1 Assistant Draughtsman.
4 European Clerks.
2 Indian Draughtsmen.
3 Goan Clerks (one added in 1926).

Trigonometrical Survey.—Base Measurement.—In 1925 a base was measured in the District of Teso. The Geographical Section, General Staff, lent the invar tapes and the outfit was completed by the purchase of index tripods and tension weights. Curiously enough, these weights were found to be inaccurate, averaging 10.164 Kgms. instead of the 10 Kgms. specified. The final length of 19,906.7065 feet is subject to a probable error of ± 3/5 of an inch or one part in 395,117. The estimation of this error starts,

however, by taking into account the one part in a million of the N.P.L. standardisation, and due allowance is made for all other subsequent and possible sources of error. The description of measurement, the tables published in the 1925 Report, and the careful analysis of error are sufficient evidence of the development of this survey from a geodetic point of view.

Primary Extensions to the Arc.—In the 1926 Report a diagram shows the longitudinal chain which starts from the Uganda Arc and reaches the eastern frontier, joining the Anglo-German boundary triangulation on the side Seavona-Misoma.

The average triangular misclosure of 68 fully observed triangles is ± 2″.849—which is too high to come into first order classification. Considering the comparatively small distance between bases, however, it is probable that this chain will be as permanent in character as it will be useful. Some further analysis of the base and recomputation may reduce the linear misclosure (1/12,672).

The last lap of this chain, from the new base to the old Anglo-German Boundary Triangulation, gives a poor linear check (of 1/8,580), but shows that had the new base not been measured a fairly close agreement both in azimuth and in scale could have been got between the Uganda Arc and the Boundary Triangulation; this agreement must be regarded as fortuitous: the Boundary Commission triangulation was not of the first order and cannot be regarded as definitive.

Another longitudinal chain (the Ankole chain) of 14 fully and three partially observed triangles between the Uganda Arc and the old Uganda triangulation side—Kankamba-Kuangaro—was observed in 1925 and computed in 1926. The scale of the old Uganda work was found too small, but that fact has been known for some time. This Ankole chain is of the same order as the eastern chain mentioned above. No details are given of the theodolites employed: it looks as if they were hardly up to the work expected of them.

New Values for the Arc.—Since the 1926 Report was written the positions of the Arc have been redetermined by the Geographical Section, General Staff, in the light of Professor Dehalu's astronomical results, and advanced copies have been sent to Uganda. A statement of the changes involved in all surrounding triangulations is on the point of going to press.

Main Circuit Traverses.—31 and 49 miles of main traverse were completed in 1925 and 1926 respectively. A very creditable closure of 1/5,000 is reported in 1925. It would be interesting to know the conditions of closure which are laid down by the Department.

Topographical Survey.—1926 sees the completion of the 1/50,000 survey of Toro and Ankole. The actual completion of the minor

orders of triangulation simultaneously with topography is probably an excellent arrangement. It is seldom realised that the link between the two is so strong that both are bound to profit from a common leadership.

Some 1,300 square miles have been completed in both respects by two surveyors.

Cadastral Surveys.—The cadastral survey of the estates guaranteed under the Uganda Agreement of 1900 has made good progress in five counties of Buganda. Based on trigonometrical and traverse control, carried out simultaneously, this survey is now passing into areas of sparse population and scanty labour. The output for the two years is about 320,000 acres and the total area covered since the commencement in 1904 is 9,379 square miles or about 56 per cent. of Buganda. In the course of this survey, native surveyors, now under training, were found of assistance.

Another cadastral survey, at 1/10,000, based on properly controlled planetable traverses, is being made of native estates in Toro. Simultaneously with this survey, scattered patches of triangulation, antedating the general trigonometrical control, were picked up and properly "placed." Two surveyors, and part time of a third, were employed. Two hundred and forty-three square miles out of a total of 376 have now been demarcated.

Surveys of various sorts were carried out on Crown land. Trading and township plot surveys reach a yearly total of nearly 1,000, agricultural and miscellaneous of nearly 9,000 acres. In 1926 no less than 822 cotton market plots and 28 ginnery sites were surveyed.

Maps.—The very large number of sunprints issued is evidence of the need of Uganda, as of other East African Colonies, for a good system of reproduction. Eventually, and without question, the example of the Gold Coast and Nigeria will have to be followed and a lithographic establishment installed. Meanwhile the Fort Portal 1/250,000 sheet N.A.36.S. and part of N.A.35X have been completely fair drawn in Uganda and the War Office is undertaking publication.

The Lands Office.—1925 was a year of great activity and unexpected revenue. In the townships and in agricultural areas (with the exception of Buganda) land is practically entirely in the hands of the Government. Leases play an important part in the revenue therefore, and, although they are kept low, are subject to periodical increases as development proceeds. Survey fee receipts were exceptionally heavy in 1925, but fell off in 1926 because the accumulation of arrears in the Buganda *mailo* estates had been cleared off by then.

The number of final certificates of ownership for native estates in Buganda was: in 1924, 915; 1925, 279; 1926, 261; whilst

2,156 provisional certificates were endorsed in 1925 and 1,276 in 1926.

There appears to be a healthy and growing demand for land among the natives which seems likely to end in a population of free peasant proprietors.

Dealings in Crown lands have been mainly in regard to building plots in townships, trading centres, and cotton markets, but in 1926 a demand for coffee land developed in Toro.

The routine work of the administration of Crown properties grows steadily. Thus in 1926 over 2,000 Crown leases were current.

Conveyancing.—Conveyancing shows the same tendency to expand as does the rest of the Department. The table given below is taken from the 1927 Report. The apparent decrease in 1926 is due to the fact that many fees for work done in 1926 were credited to 1925.

	1921.	1922.	1923.	1924.	1925.	1926.
Grants of Freehold—						
Township	—	1	1	—	1	—
Agricultural	4	—	9	4	4	5
Ginneries, etc.	—	—	—	—	2	2
Missions	—	—	—	—	—	96
Leases—						
Township	57	26	24	148	213	283
Agricultural	3	5	9	21	6	12
Ginneries, etc.	8	11	26	7	56	13
Cotton plots	—	—	—	—	387	205
Miscellaneous	—	—	—	—	—	3
	72	43	69	180	669	619
Leases cancelled—						
By forfeiture	2	20	86	23	—	1
By surrender	17	11	11	22	8	16
By grant of freehold ...	5	1	5	3	—	4
	24	32	102	48	8	21
Conveyancing Fees	£691	£760	£811	£1,578	£3,303	£1,948

Mines.—As regards mining, the prospect for tin in the Ankole and Kigezi regions seems good and negotiations in the several oil mining companies are proceeding.

The revenue from mining licences amounted to over £1,300 in 1926.

Office of Titles.—The Torrens system of land registration is gaining in popular esteem. The reports show the native tendency to unofficial dealing, speculation, and transfer of land, but the present increase in registration fees indicates that the value of secure and legal tenure is penetrating the native mind.

Revenue and Expenditure.—The following tables speak for themselves :—

1. REVENUE.

Heads of Revenue.	*Actual Receipts,* 1925. £	Shs.	Cts.	*Actual Receipts,* 1926. £	Shs.	Cts.
No. 3. Fees, etc.—						
Endorsements and Copies of Provisional Certificates.	222	10	00	181	16	00
Land and Survey Fees (Uganda Agreement).	2,499	17	43	1,172	14	40
Land and Survey Fees (Other)...	3,712	0	91	1,975	7	58
Preparation of Deeds	3,303	10	00	1,947	18	86
Registration of Titles Fees ...	2,314	6	00	2,061	6	00
Sale of Printed Maps	245	14	00	491	7	90
Sale of Township Markstones ...	146	2	00	205	7	00
No. 5. Rents of Government Property.—						
Land Rents	20,990	11	91	19,380	11	68
Salt Deposits	62	10	00	125	0	00
Water Rights	34	4	00	18	1	58
No. 9. Land Sales.—						
Sales of Land	—	4	00	1,711	0	25
Premiums on Leases	510	0	00	2,670	18	33
No. 2. Licences, etc.—						
Prospectors' Licences	283	6	00	1,357	10	00
	£34,324	16	25	£33,298	19	58

2. EXPENDITURE.

	Actual Expenditure, 1925. £	Shs.	Cts.	*Actual Expenditure,* 1926. £	Shs.	Cts.
No 27. Land Survey Department.						
Personal Emoluments	21,038	5	74	19,033	12	72
Other Charges	5,381	15	06	4,575	5	50
	£26,420	0	80	£23,608	18	22

The yearly reports from Uganda are admirably drawn up documents.

ANNEX.

The following is an analysis by the Colonial Survey Committee of the reports of the Survey Department of the Anglo-Egyptian Sudan for the years 1925 *and* 1926 :—

Anglo-Egyptian Sudan, 1925.

Governor-General.—Sir G. F. Archer, K.C.M.G.
Director of Surveys.—Mr. A. A. R. Boyce, C.B.E., F.R.A.S.

Staff.—Two Surveyors and the Chief Clerk retired, one Inspector was promoted Chief Town Surveyor, three new Inspectors of Survey, Grade III, were appointed, and the office of Chief Clerk filled by promotion. Four draughtsmen have been added to the topographical staff.

Expenditure.—

	£E.	£E.
Personal Emoluments—I ...	21,715	
II ...	1,430	
		23,145
Other Charges.—		
Transport	2,510	
Travelling Allowances	950	
Forage and Climate Allowances	605	
Upkeep of Motors	328	
Guides and Labourers	1,100	
Office and Stores, etc.	265	
Stationery	946	
Postal and Telephones	162	
Upkeep—Gezira Beacons ...	220	
Credit for Managil	400	
Contingencies	100	
		7,586
Total (1925)		£E30,731
,, (1924)		£E29,452

Organisation.—The Department is organized in four Sections: A. Topographical; B. Cadastral; C. Drawing; D. Mapping and Printing.

A. *Topographical Section.*—The excellent positional work in the Bahr-el-Ghazal was continued, resulting in the fixing of 11 longitude and 32 latitude stations. Wheel and compass traversing was run for 570 miles, the area covered being approximately 6,700 square miles.

In the small triangulation from Khartoum northwards towards Gedarif 70 stations were fixed in an area of 6,750 square miles.

Planetabling of the Argo District, Dongola, and wheel compass sketches from Shendi to Abu Deleig via Um Shedida and Geleita completed the field work of this Section.

Route Sketches.—Numerous sketches, etc., were received, including work in the Dinga and Nuer countries, in a large area lying between the Bahr-el-Gebel and the Bahr-el-Naam; on the Ibba River and the Abyssinian frontier; in the southern part of the Mongalla Province, etc.

B. *Cadastral Surveys.*—7,160 boundary stones were set up and their positions fixed in five months by a small party working on the Geteina Riverland Revision Settlement. Various small surveys, including a Pumping area, Sewage Farm, and Cotton area, were executed.

On the Gezira Irrigation Scheme, plans affected by Escape Channels were surveyed and areas computed. A survey was made of the new railway stations at Marangan and Fogara; compensation plots were demarcated at Makwar; about 2 kilometres at Cannabia Takarin, ½ kilom. of the Shalloha Canal, and 6 kilometres of railway diversion near Wad-el-Haddad were traversed.

In the Blue Nile Province 770 plots of the Sennar Rainland Scheme and 32 plots in Rufaa were measured up and a survey made of Government land near Wad Rawa in the Kamlin District. 1,135 beacons were repaired in the Gezira.

In Halfa Province the whole of the *seluka* land of Wadi Halfa and Sukkot was remeasured.

Town Surveys.—Steady progress has been made with the resurvey of Omdurman; over 2,500 petitions for alignments, subdivisions, and title deed plans have been received. The plans of Khartoum, Khartoum North, Abu Hamed, Atbara, Berber, El Damer, Shendi, Suakin, Tokar, Sinkat, Gebeit, Kassala, Wadi Halfa, Wad Medani (where many plots and alignments were surveyed), and other places have been kept up to date. The towns of El Obeid and Bara were resurveyed and new surveys made in some villages and at Wau.

Levelling and Contouring.—This work in the Sudan is undertaken for an end mainly cadastral. In the Gezira, 80,000 feddan were completed; at Tokar 25,000 feddan; at Khor Abu Habl, 37,000; at Kassala on the Gash, 126,000 feddan.

C. *Drawing Section.*—This section appears to include those engaged on adjustment of the control. The triangulations in the Red Sea and Kassala Provinces have been adjusted to the fixings of the Egyptian Survey; an old discordance of 24 seconds in longitude was thus reduced to 0.7 second. No account of method or origins is given. The adjustment of topographical triangulation, which is generally discontinuous, is mainly graphical.

It is proposed to carry on with this scheme by going carefully through the old records. It may be said at once that, without a

general territorial control, consisting of well-measured and well-balanced triangulation, with primary traverses of high accuracy where the nature of the country inhibits triangulation, the scheme, though eminently desirable in itself, will do little towards placing the survey of the Sudan on a permanent foundation.

The drawing output has been : 28 revised sheets on 4/M scale, three new sheets of the 1/M ; two index maps; 33 special and 54 town maps.

D. *Mapping Section.*—18,500 maps were printed and 16,000 issued during the year—an increase of nearly 50 per cent. on the preceding year. A new flat-bed power-printing machine has been installed by the Sudanese staff.

Miscellaneous.—The examinations for native assistants showed disappointing results, the passes being 12 per cent. only of the entrants. A training school was run in the Red Sea Hills during the summer, for which a Manual in English and Arabic has been prepared.

Remarks.—The reports are regarded mainly as a record of work, which is of a more varied description than is usual in a British Colony ; as such they are complete and prepared with care. Their failings lie in the absence of technical information, such as description of methods, accuracy sought and obtained, and the like, and of general tabulation of cost rates, without which the efficiency of the survey must remain somewhat obscure ; systematic statistics of progress, accuracy, and costs per unit are the best guides a Survey Department can possess as to the success of its own labours. These reports, furthermore, are too diffuse : it is difficult in many instances to be assured that work assigned to a provincial heading, for example, has not been summarised elsewhere.

Anglo-Egyptian Sudan, 1926.

Governor-General.—Sir G. F. Archer, K.C.M.G.

Director of Surveys.—Mr. A. A. R. Boyce, C.B.E., F.R.A.S.

Expenditure and Revenue.—

	£E		£E
Personal Emoluments ...	24,864	Increase	1,549
Other Charges	8,921	,,	1,762
Total	£E33,785	Increase	£E3,311

Travelling, transport, and labour involve heavy expense in this great expanse of country.

The revenue is made up of Survey Fees, £E464; sale of Cadastral and Topographical Maps, £1,350 ; total, £1,814, of which £E824 was charged to Departments.

Staff.—Three members of the European staff (including the Director) had retired by the end of the year and three appointments were made. In the native staff there was a single change.

Trigonometrical and Topographical Surveys.—1,200 square miles of Minor Triangulation were covered in the southern part of Mongalla Province. A topographical survey of the country around the proposed new Administrative centre at Juba was executed and a detailed hydrographical survey was made of the White Nile from Rejaf to Juba.

Cadastral work.—850,000 feddan were surveyed for land settlement in the Mergaz of Menagil (1 feddan = 1.04 acres), involving 1,208 planetable sheets on the scale of 1/4,000; a general map of the area was drawn on the scale of 1/150,000.

The Geteina River, Rawa, and the Berber Land Settlement schemes have entailed a considerable volume of work. Survey and demarcation have followed the construction of the Makwar dam. The proposed Jebel Aulia dam has given rise to the need for more accurate survey, which is in course of execution.

Town Surveys.—To keep the plans of towns up to date is part of the annual routine. The towns of Roseiris and Tendeli were resurveyed.

Gezira Contour Survey.—A big effort was made in the Gezira in 1926, 907,000 feddan, or 1,474 square miles, being levelled and contoured at ½-metre intervals, each map showing 300 spot levels. The total area completed is 1,919,000 feddan, approaching one-half of the whole Mesopotamian area. The cost appears to be kept down to a very moderate limit, 1½*d.* to 2*d.* per acre, with a tendency to decrease, partly by reason of the substitution of motor for camel transport. A rigorous survey of the canal system has been instituted.

Drawing.—Plans of Wau were drawn on the scale of 1/5,000. Twenty-six maps of the 4/M series and two of the 1/M series were redrawn. One of the 1/2 M maps was drawn for reproduction by the War Office. Drawing work, all now executed by Indian and Sudanese draughtsmen, has increased four-fold since 1922.

Mapping.—37 special maps and 427 sun-prints and tracings were supplied to various public bodies. 16,000 maps were printed; 1,170 sold for cash realised £238. A new zinc graining machine was made locally for £E.43 and the colour printing, begun in 1925, was continued successfully.

School.—The Summer School at Sinkat does not appear to reveal much aptitude on the part of the pupils, but one notes that individual native assistants in the Department receive much commendation.

Remarks.—The retiring Director states that the growth of development in the Sudan is now so rapid that the present staff is inadequate to cope with the increased demand for work in the field.

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Colonial Survey Committee

1928

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COLONIAL SURVEY COMMITTEE REPORT, 1928.

The Report reviews survey work done during the year 1927, *or, in the case of Survey Departments whose departmental year ends on the* 31*st March, the year to* 31*st March,* 1927. *In cases where the annual report of the Survey Department has been received in time the subsequent year* 1928 *or* 1928–29 *has also been reviewed.*

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

W. C. BOTTOMLEY,
Chairman.

H. P. DOUGLAS,
Rear-Admiral and
Hydrographer of the Navy.

E. M. JACK,
Brigadier and D.G.O.S.

M. N. MACLEOD,
Colonel,
General Staff, War Office.

G. T. McCaw, E. B. Bowyer, } *Secretaries.*

September, 1929.

UNIFORMITY IN MAPPING.

The Colonial Survey Committee desires to re-state in the following terms, the conditions as to uniformity in topographical and cadastral maps and scales advocated in its Report of 1907.

The great variety of the natural conditions of the surface features of the Colonies, Protectorates, and Mandated Territories renders it impossible to lay down any uniform system of work in the field. Each case must be dealt with on its merits. The technical methods suitable for different types of country (such as undulating grass regions, forest clad mountainous tracts, deserts, or mangrove swamps) are well known.

Uniformity is, however, required in the following particulars :—

(*a*) The figure of the earth adopted for Africa is the Clarke 1880 figure except in so far as present figures in use cannot be altered.

(*b*) Topographical large and medium scale maps are to be bounded by roundly numbered grid lines of the same projection (also orthomorphic if possible) as that of the cadastral series, except in so far as a topographical series based on the graticule cannot now be altered.

(*c*) The recommendations as to scales remain as in 1907, i.e. :—

Topographical Maps.	*Cadastral Plans.*
$\frac{1}{62,500}$	$\frac{1}{2,500}$
$\frac{1}{125,000}$	$\frac{1}{5,000}$
$\frac{1}{250,000}$	$\frac{1}{10,000}$
$\frac{1}{500,000}$	
$\frac{1}{1,000,000}$	

In exceptional cases where large scale town plans are required the following scales may be adopted :—

$\frac{1}{500,}$ $\frac{1}{1,000.}$

COLONIAL SURVEY REPORTS.

British Honduras, 1927.

Governor.—Major Sir J. A. Burdon, K.B.E., C.M.G.
Surveyor-General.—Mr. F. W. Brunton.

Staff.—Six surveyors and seven members of office staff.

Expenditure and Revenue.—The expenses of the Department amounted to £6,100, of which the personal emoluments were somewhat less than two-thirds. The revenue from rents, sales of land, and licences showed a gratifying increase to £5,100.

Triangulation.—Apparently the work of the year was mainly confined to reconnaissance, clearing, and beaconing, together with the choice of a site for a base of verification.

Topography.—The topographical survey was mainly of the nature of reconnaissance, particularly on the Southern Pine Ridge.

Engineering.—Engineering surveys were confined to road and water communications. Five miles of the Belize-Libun canal were laid out.

Cadastral.—Work continues on the opening of the Guatemalan boundary. The usual routine work on estate boundaries, agricultural and town lots and the like was supplemented by a re-survey of the town of Punta Gorda.

Office.—Registration, leases, sales, and licences completed the work of the Department.

Ceylon, 1927.

Governor.—Sir H. J. Stanley, K.C.M.G.
Surveyor-General.—Mr. A. H. G. Dawson.
Deputy Surveyor-General.—Mr. C. R. Lundie, A.M.I.C.E.
Assistant Surveyor-General.—Mr. G. K. Thornhill, F.R.G.S.

Staff.—Field staff about 370 ; office staff, 450 ; observatory staff, 6, including Superintendent.

Expenditure.—£240,000, of which two-thirds involves salaries, wages, &c.

Topography.—The sheets of the excellent 1-inch map of Ceylon are now all published. Revision is calculated on a 7-year cycle in the populated areas. As the Revenue Survey progresses, changes in the topography are noted at headquarters.

Triangulation.—About 40 stations were occupied for minor triangulation to control the Block Surveys. Many others have been beaconed.

Precise Levelling.—Up to date about 600 miles of accurate levelling have been completed. There are special difficulties in Ceylon, where differences of level on lines of the net sometimes exceed 6,000 feet.

Staves with invar strips are carefully standardised and the formula for permissible discordance between forward and backward levelling has been fixed as $0.005 \sqrt{F}$ feet, where 1,000 F is the distance in feet between bench-marks. Even on the lines of greatest difference of elevation, the circuits are showing admirably low closures, of the order of 2 inches on long lines. During 1927 about 20 per cent. of the lengths were relevelled. The cost, all relevant expenditure included, is 95 rupees per mile of double levelling. Intermediate bench-marks cost from 10 to 15 rupees per mark, as an average.

Block Survey.—About 130,000 acres or 200 square miles of block survey were covered during the year, at a cost varying from 3 to 7 rupees per acre and showing an average of Rs.5.67 or 7*s.* 6*d.* per acre.

Settlement and Town Surveys.—In a populous island these surveys occupy much of the attention of the Department. The Town Surveys are being based on rigorous theodolite traverses.

Application Surveys.—Application and miscellaneous surveys during the year numbered 6,500, an increase of 10 per cent. over the previous year.

Wireless Time Signals.—Time signals are emitted from the Observatory through the Welikada Wireless Station at 6 and 17 hrs. Greenwich Mean Time ($11\frac{1}{2}$ and $22\frac{1}{2}$ Local Mean Time) and are received and corrected at the Observatory itself.

Longitude.—A new wireless time determination gives the longitude of the transit instrument as 5 hrs. 19 mins. 28.69 secs. E., i.e., 0.49 secs. less than the previously accepted value. In this connection the influence of the monsoons on time determination has been very fully studied, and experiments have been conducted to test the extinction method of reception.

Meteorology.—The Department maintains its extensive meteorological services for the benefit of the Island.

Training School.—In a large service training is very necessary and a school is maintained for the purpose.

Mapping.—The demand for maps continues to grow and a new Quad Crown offset and proving press was set up. The Department so far as is known, is the only one in the Colonies which prepares plaster models, for which there is still a demand. Instead of hand colouring, these models are now covered with specially constructed lithographic prints.

Reorganization.—Re-arrangements in the Head Office have led to an improvement in accommodation for the Department.

Ceylon, 1928.

Governor.—Sir H. J. Stanley, K.C.M.G.
Surveyor-General.—Mr. A. H. G. Dawson.
Deputy Surveyor-General.—Mr. C. R. Lundie, A.M.I.C.E.
Asst. Surveyor-General.—Mr. C. K. Thornhill, F.R.G.S.

Staff.—The staff was made up as follows :—Field, 370 ; office, 450 ; observatory, 6.

Expenditure.—£250,000.

Topography.—Of the 1-inch map, 1,420 square miles were revised at a field cost of 16*s.* per square mile.

Levelling.—During the year, 634 miles were completed, whereof about 20 per cent. were double-levelled. The staves were recalibrated to an accuracy of about 0.00015 foot. The results show that the closing of the circuits on hilly lines is as good as on flattish lines ; the same fact has been observed elsewhere and is attributed to the shortening of the bays on heavy slopes. The permissible error is recorded in the 1927 Abstract ; actually the closures are of the order of $1\frac{1}{2}$ inches—an excellent accordance. The total inclusive cost of the double levelling was £6 per mile.

Bench-Marks.—The bench-marking of 4 lines (93 miles) during the year completed the whole net. A primary bench-mark costs £2 13*s.* 0*d.* They are placed at intervals of about half-a-mile.

Tide Gauges.—The tide gauge at Colombo has been re-established and the new gauge at the R.N. Dockyard, Trincomalee, is now working.

Cadastral Surveys.—133,000 acres of block survey were measured by 170 surveyors at a cost of 7*s.* per acre. 22,000 acres were measured for settlement. Block plans covering 130,000 acres in 22,700 lots, and topographical plans covering 7,500 acres in 430 lots were issued to the Settlement Officer.

Town Surveys of 7 towns were completed and the plans of three of them issued. Plane-tabled on a rigorous control, the admeasurement of these congested towns costs only about £1 per acre, including the production of the plans.

For Application Surveys 5,380 demands were received during the year. About 36,600 acres in 20,500 lots were surveyed at a cost of less than 30*s.* an acre.

The Department is wisely paying much attention to the land-marking with a view to future saving of disputation and reparation.

Other Services.—The instructive experiments on seasonal effects on the time-keeping at the Observatory were extended and the duties of the various meteorological and training services were continued, training being provided for Railway Surveyors in addition to that for the Department itself.

Cyprus, 1927-28.

Governor.—Colonel Sir Ronald Storrs, K.C.M.G., C.B.E.
Director of Land Registration and Surveys.—Mr. B. T. Watts, O.B.E.

1. *Organization of Department.*—

(i) Survey Branch ... ... Strength 88.
(ii) Valuation Branch ... ... Strength 41.
(iii) General Registration Branch ... Strength 32.

2. *Cost.*—

Expenditure incurred in year.

	£
(*a*) Survey	9,136.
(*b*) Valuation	2,830.
(*c*) General Registration	3,595.
	£15,561.

£203 was realized by sale of maps.

3. *Survey Branch* activities include :—

(*a*) Continuation of 1/5,000 plane table survey in Paphos Forest and forests above Kythrea. Average cost per acre, £0.047.

(*b*) Re-survey of Nicosia town. 1/500.

(*c*) Triangulation and traverse of Famagusta and Varosha towns for 1/500.

(*d*) Revision work on Town Surveys of Nicosia and Limassol.

4. *Triangulation* was involved by the above as under :—

(i) 4th order triangulation in Paphos Forest. 222 points fixed and observed at an average cost of £0.57 per point.

(ii) Fixing 45 points for new Town Surveys.

(iii) Computing above by means of Brunsviga machine.

5. *Topographical Survey.*—775 square miles were reduced to a scale of 2 inches to a mile and 1,134 square miles to the scale of ½ inch to a mile.

It was hoped during the coming year to reproduce part of Cyprus on a ½ inch to a mile plan.

6. *Cadastral Survey.*—1,320 traverse points were fixed for 1/500 surveys and re-surveys.

7. *Drawing, Plotting, and Computing.*—138 plans were plotted by means of the Co-ordinatograph.

Plans were checked, numbered, computed, clean-drawn, typed, and examined.

3,386 plans were sun-printed as compared with 3,333 the year before.

8. *Valuation Branch.*

The branch is divided into field and office staff.

It was hoped to complete the valuation of the whole Island by 1929, the date specified in the Law of 1907.

39 villages were dealt with, a total acreage of 106,792 acres.

The average daily output of a pair of Valuers (one Government and one popular) was 67.46, these holdings involving land, trees, or buildings. This is less by 4 than last year, but owing to the hilly country the output can be considered as satisfactory.

9. *General Registration Branch.*

This Branch comprises two sections :—

(*a*) The Field Record.

(*b*) The General Registration of Titles.

The Law of 1907 provides, in addition to the valuation of the Colony, for the registration of all unregistered holdings in a compulsory manner, with the result that after the survey a settlement of titles follows. The Field Record relates to the investigation in the field of title to property and to preparation and service of notices upon holders.

This branch refers to the preparation of Land Registers and issue of Title Deeds.

The average daily output of each field clerk amounted to 16 holdings per diem.

10. *Compulsory Registration.*

(*a*) The following totals show assessment and collection of fees in towns and villages compulsorily registered up to 31st March, 1928 :—

FAMAGUSTA AND NICOSIA DISTRICTS.

Registration Fees	£31,281
Collected	£28,214
Number of Title Deeds issued	437,759
Number of Plots	276,994.

(*b*) Registration fees collected during the year amounted to £2,247.

(*c*) 30,716 title deeds were issued.

(*d*) 14,413 plots were registered.

(*e*) Average daily output in title deeds issued and plots registered by each clerk during the year was 14.

This is an increase of 3 per day on the previous year due to the greater number of title deeds issued in proportion to plots registered.

Federated Malay States, 1927.

High Commissioner.—Sir Hugh Clifford, M.C.S., G.C.M.G., G.B.E.

Surveyor-General.—Mr. V. A. Lowinger.

Assistant Surveyor-General.—Mr. J. Dewar (who succeeded Major C. J. Perkins, I.S.O., in October).

Finance.—The net cost of the department was $1,054,378, $33,447 less than in 1926.

Progress of Revenue Surveys.—The number of requisitions outstanding increased from 15,252 to 18,523 during the year.

Triangulation.—The triangulation of Pahang was completed. No standard traversing or precise levelling was done in 1927.

Topography.—Approximately 1,321 square miles were surveyed; the cost varying from $132 per mile for the standard sheets in Kedah, to $7,721 per mile for the 80-inch town plan of Kuala Lumpur.

Map Production.—The output of the photo-litho station was nearly double that of 1926, with a corresponding increase of revenue from the sales thereof.

Various forest maps were produced from air photographs supplied by the Air Survey Company.

Meteorology.—The responsibility for meteorological activity came under the Survey Department as from the 1st January, 1927.

A comprehensive scheme has been approved by the Governments of the Federated Malay States, Straits Settlements, and Unfederated Malay States, whereby 17 "second order stations" will be established in the peninsula. By the end of 1928 nine of these should be at work.

In addition it is hoped to establish with the co-operation of the planting community 200 (and eventually 500) minor stations for temperature and rainfall observation.

Training.—Recruiting has been carried on satisfactorily, in spite of a scarcity of suitable applicants.

A successful refresher course for subordinate officers was held at Port Dickson during February.

The results of the 1927 examinations have been particularly gratifying.

General.—The 20-year-old departmental regulations have been re-written and published during the year.

Fiji, 1927.

Governor.—Sir Eyre Hutson, K.C.M.G.
Commissioner of Lands.—Mr. C. A. Holmes.

Staff.—Lands Department: 5 surveyors, 5 draughtsmen, and 3 clerks. Native Tribal Boundary Survey: 6 surveyors, 2 native draughtsmen, and pupils.

Triangulation.—New secondary trigonometrical stations to the number of 15 were established. There are now 213 of such stations in Viti Levu, and 93 in Vanua Levu. Eight beacons were reconditioned.

Main Traverses.—There were run 32 miles of control traverses. It would be interesting to know the closures obtained, as well as the method of tying into the trigonometrical controls where, as commonly, the slopes encountered present much more than ordinary difficulty.

Native Tribal Boundary Survey.—The area covered was 58,860 acres in 222 lots, averaging 265 acres per lot. With a view to increasing progress, four new surveyors will be added and two vacancies filled. The wooded nature of much of the country and labour difficulties rendered progress slow.

Investigation Surveys.—Of the plans presented by the six licensed surveyors in the Group, 450 were passed, covering 7,852 acres. To check plans which were found to be incompatible with insertion on the standard sheets, 42 investigation surveys were executed.

Miscellaneous Surveys.—These dealt with seven Crown and 14 Native Leases, sub-divisions, and minor surveys in towns. Awaiting survey there are 58 Crown and 620 Native Leases ; this is a reduction of the total by 215 since the previous year. The arrears are being steadily reduced ; moreover some of the properties on the books have probably been abandoned.

Registration.—Titles of new, extended, transferred, and resumed leases, to the number of 1,253, were sent for registration.

Mapping.—Nearly all the mapping is cadastral, five new sheets of the Tribal Boundary Survey were undertaken, bringing the total to 116. A new plan of Suva was prepared for publication and small-scale tourist and forest maps issued, the latter in connection with a renewal of interest in forestry. 1,183 plans and tracings and 239 sun-prints were produced.

Gold Coast, 1927-28.

Governor.—Sir A. Ransford Slater, K.C.M.G., C.B.E.
Surveyor-General.—Mr. J. Clendinning, B.Sc., A.M.I.C.E.
Deputy Surveyor-General.—Mr. F. W. Mindham, B.Sc., F.R.G.S., F.R.A.I.

Staff.—Office staff of 77, field staff of 97, including three special parties, i.e., Cadastral Framework Party, Topographical Survey and International Boundary Surveys, and Forest Reserves Boundary Survey.

Topographical Work.—Except for a small area, which would probably be taken in hand in October, 1928, the topographical map is now complete as far north as the 7th parallel.

The western frontier topographical sheets are now completed to the actual frontier from the sea as far north as 8° 30′ N., with the exception of a strip of country 30 miles by 7 miles.

Lines of levels, 500 miles in extent, have been completed in the Mandated Territory, thus providing a vertical framework for topographical survey. In addition other lines of levels and astro-radio points have been laid down.

Revision of some of the earlier topographical sheets has begun. As a very accurate primary framework is now available over a considerable portion of the southern half of the Colony, work will be adjusted to the new values on sheets that are being redrawn. Subsequent editions will be more complete and more accurate. Apart from the Boundary Commissions, future topographical work will be divided into revision and original surveys. The latter, in the majority of cases, being hung on astro-radio points, will form the first edition, but as revision proceeds this will be replaced by more accurate editions.

Cadastral Work.—Provincial survey sections have carried out various Boundary, Railway, and Acquisition Surveys as well as some Town Surveys and preliminary surveys for land disputes. Some town revision has been begun.

It was found that a Town Survey carried out by native surveyors was satisfactory as regards accuracy, but that the cost was high when there was no European supervision.

The total costs of Town Survey have varied from £1,283 to £2,223 per square mile.

Forest Reserve Boundary Surveys have been proceeded with, bringing the total area surveyed up to 31st March, 1928, to 783.85 square miles and the total perimeter to 884.3 miles.

A special Town Survey party was to start work in October, 1928. It was estimated that surveys of 46 towns were needed, and the expenditure, to be spread over five years, would be £60,000.

Cadastral Framework.—One party was employed on this work and completed 100 miles of traverses during the year. The total error on a completed traverse of 401,700 feet was 12.55 feet—a satisfactory result.

International Boundaries.—The boundary between the Gold Coast and the Ivory Coast should be complete by June, 1928. Some difficult country was encountered with hills up to 2,000 feet and slopes up to 42°.

The boundary between French and British Mandatory spheres in Togoland should be complete by June, 1929. The main work of the British party was the topographical survey of a strip of difficult country two miles wide. This survey was hung on astronomical points and on a traverse line between these points.

Wireless Time Signals.—Eighteen points were fixed during the year by this method, bad weather delaying the star observations in many cases.

The new short wave-length signal (32 metres) from the Eiffel Tower appears to be more satisfactory than the Bordeaux signal on a wave-length of 18,900 metres.

Difficulty was experienced in getting good results from the time sent from Greenwich via Rugby (GBR), as no warning signal was sent.

Star Observations.—The method of obtaining local time was that by observations on pairs of east and west stars. A probable error of less than ± 0.5″ was normally attained.

For the latitude of pillars to be used in the Boundary Commission Survey the circum-meridian method was used. A probable error of less than ± 0.2″ was obtained.

For topographical framework only four shots were taken on each star, thus cutting down the time on one star from 8 minutes to 3 minutes.

Astronomical observations were taken at one point on the main triangulation, the following being the results :—

	Trigonometrical.	*Astronomical.*
Latitude ...	... 5° 16′ 18″.9 N.	5° 16′ 22″.5 N.
Longitude	... 1° 58′ 23″.6 W.	1° 58′ 34″.9 W.

Reproduction Department.—In addition to the normal work of this department a book of maps and diagrams forming an " Atlas of the Gold Coast " was produced.

Survey School.—A small Survey School, for which new buildings were under construction, was maintained.

During the year, 15 boys were under training as surveyors and four as building inspectors.

Hong Kong, 1927-28.

Governor.—Sir C. Clementi, K.C.M.G.
Superintendent of Surveys.—Mr. E. B. Reed, P.A.S.I.
Assistant Superintendent of Surveys.—Mr. F. Sutton, F.S.I.

The Survey Office forms part of the Public Works Department.

The staff consisted of 9 Europeans and 27 Chinese, and in addition 73 Coolies, at wages varying from $11.00–$25.00 (22*s.* 6*d.*–51*s.*) per mensem were employed. The cost of the Survey Office excluding overhead charges was nearly $153,000, or £15,618 approx.

Trigonometrical Work.—The eastern portion of the Colony on the mainland, which was not included in the main triangulation, was completed. The stations, which were beaconed, formed a system of 22 triangles, the average correction for error to each triangle being 3.2″. The work was tied in to the main triangulation of the Colony.

On the island of Hong Kong beacons were erected on a further 8 stations, which together with others from which observations were made, were tied in to the original triangulation with very good results.

Permanent cairns were erected at eleven stations and these will be eventually connected up to the main triangulation.

Revenue Surveys and General.—Surveys were made for plans to be attached to Crown leases for 285 lots. Four surveys totalling 375 acres were made in detail and large scale contour surveys of six areas, amounting to 163½ acres.

A survey of the Kowloon Bay reclamation came to 183 acres, and two others on Hong Kong Island were commenced.

Boundaries of 146 lots were defined and boundary stones fixed to 212 lots. Numerous other lots were roughly delineated, street frontage lines were checked, and numbers of permanent marks at the intersection of streets and proposed streets were fixed. Many other small surveys of miscellaneous character were made and plans prepared for departmental uses.

Ordnance Survey.—Revision work has been carried out to the extent of 18 acres and 6 areas of 800 acres in all have been surveyed during the period. Two traverses of 4.8 and 9.12 miles respectively were run.

New Territories.—Of these, the most important surveys covered an area of 614 acres, the total length of traverses being 85,500 feet.

Jamaica, 1927.

Governor.—Sir R. E. Stubbs, G.C.M.G.
Surveyor-General.—Mr. W. Anthony Baker, F.R.G.S., F.S.I.

There is in the strict sense of the term no Survey Department in the Colony. The Lands Department is charged with the administration of the Crown lands, about 281,000 acres, and as its name implies, is primarily a Lands Department.

The staff consisted of 1 Assistant Surveyor-General, 3 surveyors, 1 draughtsman, and 5 clerks. The gross expenditure was £5,363.

Surveys.—There was a shortage of staff during most of the year and moreover it was found difficult to secure the services of surveyors in private practice for surveying and allotting lands sold to small settlers. The surveys performed were all cadastral in character, showing in the case of closed traverses errors ranging between 1 in 300 to 1 in 15,700. The lineal extent covered by these surveys amounted to 33⅓ miles at an average cost of £6 18*s.* 5*d.* per mile with an average daily progress of 48 chains.

Checking and Preparing Plans for the Registration of Titles.—The method of testing plans was purely theoretical and proved unsatisfactory. In every case, without exception, in which the Department made a test on the ground, inaccuracies were disclosed which would otherwise have passed the theoretical test.

During the year, only 22 per cent. of plans submitted passed the examiner on first submission.

The work done for the Titles Department is increasing year by year, the amount done in 1927 being 95½ per cent. more than that in 1922.

Maps.—A number of maps, plans, tracings, and prints were prepared for official use or supplied to the public.

Crown Land Development did not make much progress and the surveying and permanent marking of the proposed Blue Mountain Forest Reserve was still in abeyance at the end of the year, owing to lack of funds.

Nigeria, 1927.

Governor.—Sir Graeme Thomson, G.C.M.G., K.C.B.
Surveyor-General.—Capt. T. J. Waters, R.E.
Deputy Surveyor-General.—Capt. J. Calder Wood, M.C.
Assistant Surveyors-General.—Capt T. H. Galbraith, M.C., and Capt. C. G. Evans, R.E.

Staff.—The nominal roll contains 41 surveyors and 4 officials on the Headquarters staff. There are in addition special parties as follows :—

2nd Colonial Field Survey Section—5 officers and 24 N.C.O.'s.
Topographical Survey and Wireless Officer—6 officers.

Besides this staff a number of Africans are employed in the Provinces. Thus, in the Southern Province there are 27 surveyors and 13 pupils ; 17 draughtsmen and 8 pupils. In the Kano Section there are 106 employees, 17 of whom are under the Government.

Triangulation.—A base was selected near Minna in the chain of the first group, stretching from Minna to Eruwa. The method of observation would appear to prescribe measurement of angles in all combinations on five arcs, but it is not stated how the weights of the measures are dealt with ; obviously uniform weight throughout the chain is at least desirable. The principle of limiting the number of angles in a round is clearly sound. In the Minna-Eruwa chain 50 stations were fixed and 30 occupied for observation. The inclusive costs per station were : clearing and beaconing, £44 ; observing, £29. A new type of quadripod beacon was adopted. Of squared timber, treated with solignum and embedded in concrete feet, it is strengthened with iron junctions, covered as to its upper position with matchboarding and crowned with a small inverted quadripod, so that the total height is about 20 feet.

The Udi-Lokoja-Abuja group found themselves faced with a terrain unfavourable for triangulation ; the difficulties were overcome only by the selection of two tower stations. Nine points were beaconed and 9 occupied for observation.

Determinations of latitude and wireless longitude were made at Eruwa, Minna, Kano, Jos, and Lefin Lafia. On the completion of the Minna-Eruwa chain these measures will be combined to derive a provisional standard latitude and longitude for the Colony.

The secondary triangulation is included under topography.

Traverses.—A control traverse of 80 miles from Lagos to Abeokuta was stopped by reason of sickness. In the Kano section secondary traverses showed an average error of 1/8,000.

Topography.—Two important decisions were made: (1) it was decided to form a trigonometrical framework sufficient for cadastral work as well as topography; (2) in view of the necessities of the Geological Survey, it was agreed to expedite topography by mapping on the scale of 1/125,000 instead of 1/62,500. The secondary beacons are now erected on concrete pillars; the secondary sides are from 8 to 10 miles in length and minor points are fixed at intervals of 4 miles.

The Topographical Party No. 1 in the Minna district reconnoitred, beaconed, and observed on a secondary chain which was frequently closed on primary points. The maximum error was 9″ while the average was 3″. Of primary and secondary points 9 and 34 respectively were occupied for observation, and 54 minor points fixed by intersection and resection, covering an area of 1,800 square miles. As far as possible the plane table was used, but the long grass in places necessitated chain and compass traverse and barometric heights. The rate of work averaged 5 square miles per man-day.

In the Nsukka district Topographical Party No. 2 observed at 24 secondary stations and fixed 12 minor points, which latter were marked only when there was no natural object, such as a tree, on the site. The maximum error of the secondary chain was 10″ and the average 4″. Nearly 5 square miles per man-day was the topographic output.

See also the later reference to work at Kano.

Cadastral Survey.—The survey of Lagos on the scale of 5 feet/1 mile has been completed and reproduced by W. and A. K. Johnston. These sheets were reduced photographically to the scale of 1/2,400. Investigation of titles on Lagos Island involved much labour. In the Southern Provinces a town planning scheme was surveyed at Yaba; here again investigation of titles led to an overburden on the Department. Two provincial boundaries were demarcated and various miscellaneous surveys undertaken, especially one of a reclamation scheme at Calabar; those which are isolated are expensive. There was heavy work in the drawing office and the decentralization of buildings is a handicap to the Department. Over £1,500 was recovered from fees.

In the Northern Provinces, cadastral survey is on a different basis, part pertaining to the local administration. Lay-outs for towns form an important section of the work. The Minesfield demands special survey parties. Two licensed surveyors are now engaged on the plateau. In the Minesfield, 370 mining leases covering 49,500 acres and 256 exclusive prospecting licenses, involving 730 square miles, were surveyed by the Royal Engineer Special Party, the

total fees amounting to £21,000. The departmental section's corresponding numbers were 97 Mining Leases and 99 Exclusive Prospecting Licenses, with fees totalling about £8,000. By the end of the year the arrears were reduced to 235 areas.

In the Kano Section the Revenue Survey performs the greater volume of work, with a total staff of 57 and an annual output now exceeding 80,000 acres. Here topographical sheets are being prepared by reduction from 1/2,500 to 1/62,500. Sheet No. 458 was completed during the year, while two others are in hand.

Reproduction.—The lithographic plant was removed from Kano to Lagos. The Fuka sheet on the 1/125,000 was plotted on the transverse mercator projection and its reproduction is very creditably executed. A new road map of the Northern Province was prepared on the scale of 1 M., together with a map of the Northern Cameroons.

Survey School.—This has been established at Ibadan in offices abandoned by the Royal West African Frontier Force; it accommodates about 40 pupils. Prospects appear very hopeful.

General.—The Department is occupied with surveys of a very varied nature, which adds to the difficulty of successfully summarising here its activities.

Northern Rhodesia, 1927.

Governor.—Sir J. C. Maxwell, K.B.E., C.M.G., M.D.
Director of Surveys.—Mr. W. G. Fairweather, B.Sc., A.M.I.C.E.
Deputy Director.—Mr. L. W. G. Eccles, M.C.

Staff and Expenditure.—The staff consists of 10 members, to whom a draughtsman is now added. The cost of the Department is increasing with the development of the Colony and the fees recoverable are apparently increasing at a somewhat greater rate, as the following statement indicates:

	1925.	1926.	1927.
Cost	£6,219	£7,900	£9,625
Fees Recoverable ...	£1,969	£1,178	£4,238
Percentage Ratio ...	32	15	44

Work done (Cadastral).—The main work of the year is shown in the following tables:

	No.	*Acres.*
Farms surveyed	69	61,143
Small Lots surveyed	281	833
Native Lots surveyed	1,640	878

Road Traverses...	316 miles
Demarcation of Nyasaland Border	130 ,,
Tanganyika District Native Reserves.	
Ground control for Air Survey of Townships	360 sq. miles.

Miscellaneous work under various headings which cannot be classified completes the record of the year. Some of this, undertaken for other Departments, is not directly remunerative.

	No.	*Acres.*	*Purchase Price.*	*Annual Rents.*
			£	£
Title deeds—Farm	46	16,428	19,263	—
Title-deeds—Plots	42	74	3,535	—
Permits of Occupation ...	26	76,487	11,669	597
Leases...	99	24,131	9,745	4,128
Totals...	213	117,120	£44,212	£4,725

Of the 152 survey diagrams presented for registration, &c., 7½ per cent. were returned for correction and 10 per cent. rejected as inadmissible.

Topography, Air Survey, and Hydrology.—The demand for maps on the scales 1/M and 4/M, particularly the latter, is considerable. The 1/M map is being redrawn and "degree sheets" are being recompiled on polyconic graticules as routine work permits.

The presence of the Aircraft Operating Company in the Colony has provided the opportunity for making contracts at favourable rates. In order to study the hydrology of the Upper Zambesi, a contract was placed with the Company for air photography of the river and its tributaries at low water. The cost is about £12 10*s.* 0*d.* per mile of main river.

The sites of 4 townships, about 400 square miles, in all, were photographed at a cost of £2 5*s.* 0*d.* per square mile.

Photographs of the area under the Border Concession will be supplied to the Government at a low rate.

One of the important questions facing this survey department appears to be the reproduction of its maps and plans. A small lithographic plant, possibly run largely by native labour, might add considerably to its value in development and in land settlement.

General.—The report is filled with admirable statistics of a general nature ; but its value would be increased if statistics of a technical nature were included.

Northern Rhodesia, 1928.

Governor.—Sir J. C. Maxwell, K.B.E., C.M.G., M.D.
Director of Surveys.—Mr. W. G. Fairweather, B.Sc., A.M.I.C.E.
Deputy Director.—Mr. L. W. G. Eccles, M.C.

Staff and Organization.—The effective staff, consisting of 12 Europeans, was much depleted by leave, resignation, and sickness. The office absorbs twice as much time as the field work. Branch offices are established at Kasama and Lusaka.

Triangulation.—A small area was triangulated in the vicinity of the Victoria Falls, in view of possible power development.

Cadastral Survey.—At Kasama 39 plots of 1,000 acres and 7 farms of 22,350 acres were surveyed. At Lusaka the work covered 3 farms, 2 mineral concessions, and 81 small plots. In comparing the figures for 1927, it was found that 24 farms, averaging 340 acres each, were surveyed at the rate of 66 acres per man-field day and at a cost of 1*s.* per acre, a much higher cost than usual; beacons averaged 2¼ per farm, the survey being based on triangulation. Traverse surveys of 35 farms, averaging 540 acres each, cost 7*d.* per acre, the rate of progress being 140 acres per man-field day and 96 acres per total man-day; here there were established 7½ beacons as an average per farm. Small plots, not exceeding 10 acres, cost from 17*s.* to 53*s.* per acre; while compass and plane-table surveys of large farms can be executed at the rate of 900 acres per man-field day at a cost of 1*d.* per acre. These cost rates do not include travelling and transport, leave, pensions, and various smaller items not negligible in the aggregate.

In all, the surveys controlled by the Department covered farms containing 106,500 acres and plots amounting to 290 acres. £5,100 was recovered in fees for survey, issue of title, permit of occupation, &c. The Director adverts to the impossibility of his checking in the field the non-departmental work.

Townships.—The lay-out of Choma was supplemented by miscellaneous work at Monze, Mpulungu, Ndola, Abercorn, and the new settlement of Luanshia. The photo-mosaics of Livingstone, Mazabuka, Lusaka, and Broken Hill have been passed to the Department.

Levelling.—Four cross sections were made of the Zambezi river.

Demarcation.—117 miles of the boundary between Northern Rhodesia and Nyasaland were demarcated by one surveyor at the rate of 12½ miles per month and at a cost of £6 per mile. The beacons, placed at 0.3 mile apart on the average, cost 36*s.* each.

Air Surveys.—(*a*) Nearly 600 miles of the Zambezi and its affluents the Kabompo and Lungwebungu were photographed from the air; the controls were astronomical and radiotelegraphic, and the mapping at 4 inches/1 mile is well in hand. (*b*) A second contract involved oblique photography on the Congo Border; 14 sheets have already been received. These will be reduced to form 4½ sheets of the 4/M map of the Colony. (*c*) The third contract covered with vertical photographs the townships of Livingstone, Mazabuka, Lusaka, and Broken Hill. The detail is being transferred by eidograph direct from the photograph to the map and the Director observes that, after comparison with measurements made on the ground, the errors of this method of plotting are found to be negligible on a scale of 1/2,400.

In the region (*b*)—a country of undulating bush interspersed with streams and glades (*dambo*)—under a suitable climate, he considers

that a combination of obliques with verticals taken on definite lines, controlled by stellar and wireless fixings, will produce a 4/M map with both accuracy and rapidity in excess of ground methods.

Road Traverses.—280 miles were measured at a cost varying from 3*s.* 6*d.* to 9*s.* per mile run.

Mapping.—The 1/M map has been issued in a revised form. The 1/4 M general map was reprinted. Four new sheets of 4/M map were published. Sales realized £74 and the demand is increasing.

Office.—560 deeds were drawn up and 74 tracings made for sun-prints. Meteorological results are normally issued, but could not be typed during this year. The office accommodation is reported inadequate.

General.—Notwithstanding depletion, this small Department handles no mean volume of work.

Nyasaland, 1928.

Governor.—Sir C. C. Bowring, K.C.M.G., K.B.E.
Lands Officer.—Mr. J. E. Alexander.

Staff and Expenditure.—The staff consists of 5 Europeans and 5 Africans, and the expenditure was £4,100, whereof about four-fifths consisted of personal emoluments.

Cadastral Work.—47 blocks of land, covering 21,000 acres, were surveyed in different districts. The inclusive cost is slightly under 4*s.* an acre or £80 per block.

Mapping.—Progress has been made with the revision of the 1/M map.

Palestine, 1927.

High Commissioner.—Field Marshal the Rt. Hon. Baron Plumer, G.C.B., G.C.M.G., G.C.V.O., G.B.E.
Director of Surveys.—Major C. H. Ley, O.B.E.

Trigonometrical Survey.—The whole of the principal triangulation has been adjusted in two sections, the southern involving 114 and the northern 117 equations of condition. In consequence the north-south displacement rises to a maximum of 0.″22 on the Syrian frontier and the east-west to 0.″13 at the Lake of Tiberias. The azimuths are improved.

120 stations have been added to the net of the 3rd order, bringing the total to 860 stations of density 9 per 100 square kilometres, or about 1 in every square of 2-mile side.

The fourth-order net has been increased by 1,660 trigonometrical and 260 traverse stations, making a total of 13,500 minor points or about 235 per 100 sq. kms., equivalent to 6 per sq. mile.

Trigonometrical levelling from the Imara Base to Jaffa shows an error of 1/12,500 of crow-line distance, say, 10 seconds, of arc in measured distance. On the coastal plain the average coefficient of refraction is 0.06, but this appears to increase rapidly inland.

Levelling.—Tide gauges will shortly be set up at the ports of Jaffa and Haifa. Second-order levelling, amounting to 119 kms. of line, was carried out in the town-planning areas of Jaffa and Tel Aviv, 119 B.Ms. being fixed. The seasonal variation of the level of the Dead Sea is being investigated.

Projection.—The projection is Cassini's on the meridian of Jerusalem and the Clarke (1880) spheroid is to be made standard.

Cadastre.—In Ramleh and on Carmel 295,000 metric dunams have been surveyed by the topocadastral method, i.e., 114 square miles, mapped on the scale 1/2,500. These plans will be reduced to 1/20,000 for general purposes.

On the coastal plain below Rehoboth, about 125 square miles were surveyed on the plane table at a scale of 1/10,000 and at a cost of 2 mils per dunam (about 2*d.* per acre).

The revision of the plans of Jerusalem (1/2,000) and the survey of Haifa (1/2,500) were begun during the year and the latter is in process of completion.

The total area of chain survey undertaken during the year was 14 square miles at an average cost of 13*s.* per acre, parts of the areas being close and difficult.

Various schemes for drainage, irrigation, &c., were also completed during the year.

575 plans by licensed surveyors were checked and 1,379 plans for registration were examined on the ground before acceptance. This control is therefore complete, but entails heavy duty.

Topography.—In the sinuous scrubby gorge of the Jordan nearly 60 sq. miles were plane-tabled at a scale of 1/5,000. For work of this class in an area where the present value of the work is topographic and the undertaking is arduous, it would seem that the aeroplane could be employed with advantage to all.

Reproduction.—Lithographic printing is making headway and machines may become necessary.

Units.—The following table shows the English equivalents of some Palestinian units. The *Mil* is about one farthing, actually 0.24*d.* The £P. has the same value as sterling. The *Metric Dunam* is apparently one-tenth of a hectare.

1 Native Dunam	= 919 sq. metres	=0.2271 acre.
1 Metric Dunam	=1,000 ,,	=0.2471 ,,
1 acre	=4.047 m. dunams	=4.403 n. dunams.
1 square Mile	=2,590 m. dunams	=2,818 ,,

20 mils per metric dunam=1*s.* 7½*d.* per acre.

The technical information in this report is excellent.

Palestine, 1928-29.

High Commissioner.—Lieutenant-Colonel Sir J. R. Chancellor, G.C.M.G., G.C.V.O., D.S.O.

Director of Surveys.—Lieutenant-Colonel C. H. Ley, O.B.E.

Triangulation.—The completed and adjusted main network was connected with the triangulation of Syria by a French officer. To the triangulation of the 3rd order 162 stations were added, making a total of 1,022, averaging 1 per 12 square kilometres. The 4th order net in the Maritime Plain and Jordan Valley contains 15,600 stations, having a density of about 7 per square mile.

Tide Gauges.—Primary and secondary tide gauges are maintained at Haifa and Jaffa. The ordinary rise of springs is about 15 inches.

Dead Sea and Lake Tiberias.—The regimen of these two lakes is found to be closely correlated. The flood in the Dead Sea is about half the amount and six weeks in retard of the April flood in Tiberias, which has an amplitude of 1.2 metre. At present mean lake level is falling in both cases.

Cadastral Surveys.—Large-scale survey is now confined to areas for registration at settlement, which, together with the introduction of valuation, has led to the change of system.

Preliminary topocadastral survey, plane-tabled on the scale of 1/10,000 and executed by sheets, is reduced to 1/20,000 as a provisional series for showing "fiscal blocks"; the latter are subdivided into "registration blocks," in advance of settlement, which are plotted on "registration-block plans" at the scale of 1/2,500, whereon are sketched property rights and areas for partitioning. These 25-inch plans, after adjudication, demarcation (if necessary) and final survey, are deposited for registration.

245,000 acres, involving 46 villages and 965 fiscal blocks, were thus surveyed on the 1/10,000 scale at a cost of 3*d*. per acre. In addition, over 10,000 acres on the River Kishon were surveyed by the topocadastral method on the scale of 1/2,500 at a cost of 7*d*. per acre. It is proposed to show approximate contours on these maps in future. (1 mil per dunam is closely 1*d*. per acre).

Chain Survey.—In the close orchard country around Majdal and elsewhere, chain survey of 5,500 acres in 62 blocks was finished during the year at a field cost of 6*s*. per acre. In some villages chainage was carried over roofs. Eighteen villages were chain-surveyed at a cost of 37*s*. 6*d*. per acre—a very reasonable figure.

Town Surveys have occupied more of the field time of the Department than is usual. The surveys of Haifa, Tul Karm, Gaza, and Beisan are complete and block plans ready for issue; others are in progress. The field costs on the scales of 1/2,500 and 1/1,250 have been 27*s*. and 61*s*. per acre respectively, including about 22½ per cent. for examination.

Special Surveys covered about 76,000 acres, whereof 55,000, between the Dead Sea and Jericho, was surveyed topographically at a cost of £9 per square mile.

Mapping.—A new flat-bed power press was added. Two of the provisional sheets of the new 1/20,000 series were issued; the sheets, in three colours, show trigonometrical points and heights thereof, approximate contours in red, isolated hills in hachures, cultivated lands, and boundaries. Numerous zincographic and other prints were produced.

Miscellaneous.—Plans by licensed surveyors are now checked by a special inspectorate. Ten surveyors and 9 draughtsmen were in training. New roads have considerably improved transport. The unavoidable evacuation of the old survey quarters has led to proposals for a new and more convenient site. A new Survey Ordinance, to replace the present three Ordinances, has been submitted.

Sierra Leone, 1927.

Governor.—Brigadier-General Sir J. A. Byrne, K.C.M.G., K.B.E., C.B.

Director of Surveys.—Major J. Dare, M.C.

Staff.—At the end of 1927 the staff consisted of 7 Europeans and 25 Africans. There were also 24 African pupil surveyors, and as locally trained men became available 5 Gold Coast surveyors previously lent to Sierra Leone returned during the year.

Topographical Branch.—The work was much hindered by sickness. Twelve points were fixed by astronomical observation and wireless-time signals. Azimuths were observed at each point and magnetic variation determined. All points were fully beaconed.

273 miles of instrumental levelling was completed.

8,360 miles of compass traverse with aneroid levels were run. This represents the detail survey of about 6,000 sq. miles of country on 20 field sheets, on a general basis of $1\frac{1}{2}$ traverse miles per sq. mile of country.

Fifteen field sheets, on the scale 1/62,500, were sent to Accra for publication.

An increase in the proportion of African to European staff has reduced the cost from £413 to £308 per field sheet, but it is considered that this process cannot be carried further without loss of efficiency.

It is hoped to complete the 93 field sheets, which will cover the whole of the 28,000 square miles of the Protectorate, by the middle of 1930.

Cadastral Branch.—The Survey of Freetown on a scale of 1/1,250 was completed in March, 1927. The survey of an area of about ten square miles in the vicinity of York was also undertaken urgently, and completed successfully, under very bad weather conditions. The extension of the Freetown survey towards Wilberforce, Murray Town, or Aberdeen is proceeding.

Lands Branch.—This branch carries out various duties in connection with Crown Lands, and land transactions to which the Government is a party.

Survey School.—Fourteen second-year pupils did 6 months in the field, mainly on detail survey and levelling, and rejoined the school for instruction in June. Ten first-year pupils received instruction throughout the year.

Straits Settlements, 1927.

Governor.—Sir Hugh Clifford, M.C.S., G.C.M.G., G.B.E.
Surveyor-General.—Mr. V. A. Lowinger.
Assistant Surveyor-General.—Mr. J. Dewar (who succeeded Major C. J. Perkins, I.S.O., in October).

Finance.—Expenditure exceeds that of 1926 by $47,673, while revenue has increased by $1,269. The cost of fitting out the new Singapore office is included in the figure for total expenditure, i.e., $508,648.

Map Production.—The new maps published during the year have made a very wide selection now available to the public.

Progress of Revenue Surveys.—Arrears are still considerable owing to the increased numbers of surveys requisitioned, especially in Singapore, despite overtime work.

Shortage of Staff.—The shortage in the subordinate ranks has been accentuated by resignations to go to private firms, the saturation point of which, however, must eventually be reached.

Meteorology.—Notes on the meteorological situation affecting the Straits Settlements appear under the report of the Federated Malay States.

Training.—Recruiting and training proceed as energetically as possible.

The policy of maintaining a very high standard of work is continued and only fully trained subordinates are employed.

General.—The newly created post of Senior Superintendent, Singapore, was filled by Mr. F. B. Sewell.

Trinidad and Tobago, 1927.

Governor.—Sir Horace Byatt, K.C.M.G.
Crown Surveyor.—Mr. J. W. Macgillivray, F.S.I.

The staff consisted of 4 assistant surveyors, 6 draughtsmen, and 1 clerk. Expenditure amounted to £7,768.

Topographical.—Two and a-half square miles were re-surveyed in the Piparo district in order to correct the contours and topographical detail.

Triangulation.—Thirty new minor trigonometrical stations were established in the County of St. Patrick for the control of surveys now made in connection with the new cadastral sheets. Thirty-seven stations were occupied and observed at. In one small triangle the error of closure was 13.68 seconds, but the average was, however, 5.44 seconds.

Cadastral Field Work.—407 village lots and 284 parcels of 20 acres or less were surveyed for petitioners.

Twenty-three Survey Orders were issued, containing in the aggregate about 7,500 acres to be included in the mining lease to the Trinidad Petroleum Development Company, Limited. Eight of these were completed.

Re-surveys, Surveys of Reserves, &c.—The total length of boundary lines run under this heading was 2,469 chains or 30.9 miles.

Controlling Surveys.—3,811 chains or 47.6 miles of traverse surveys connected to the triangulation were run along roads, boundaries, and rivers to provide the framework on which the surveys of the alienated lands are to be based. The average closing error in the primary class was 1 in 7,519.

Office Work.—Nine new improved copies of sectional sheets were prepared with ferro-gallic copies of each for the use of the Wardens.

972 grant, 165 lease, and 894 survey plans were made in connection with petitions and other land transactions.

The number of plans checked and certified by the Crown Surveyor amounted to 565.

Solar observations for time were taken once a week in order to determine the rate of the Standard Clock kept in this office, from which the correct time of the Colony is obtained.

General.—The year under review was one of the wettest on record and the field work of the Department was executed under very adverse conditions.

Uganda, 1927.

Governor.—Sir W. F. Gowers, K.C.M.G.

Director of Surveys, Land Officer and Commissioner of Mines.—Mr. Dyson Blair.

Deputy Director of Surveys.—Mr. H. B. Thomas.

Staff.—The staff of the Lands and Survey Department included 17 surveyors, 4 draughtsmen, and a computer.

Expenditure and Revenue.—The annual cost of the Department was about £26,000, of which four-fifths was covered by personal emoluments. The actual receipts from revenue collected by the Department amounted to £44,500—greatly exceeding the estimate. Of this amount nearly one-fifth was brought in by fees and sales of maps.

Triangulation and Main Traverse.—Triangulation is being actively pursued, present effort being mainly concentrated on a North Meridional Chain, where, however, a bottle-neck at Lira has caused some misgivings. Ten stations were completed in spite of unusually prolonged haze and difficult country. Minor triangulation was observed near Mjanji for topographical control. Of ruling traverse 94 miles were measured.

Topography.—In the Eastern Province the sheets A.36, V and W, of the quarter-inch series are in progress, contours being fixed at 100 feet V.I. The total cost of field work on 277 square miles worked out at 30*s.* a square mile.

Cadastral Survey.—In Buganda nearly 450 square miles were covered at an inclusive field cost of £8 12*s.* 0*d.* per square mile. This involved 1,260 miles of boundaries and tie lines, costing £3 10*s.* 0*d.* per mile, inclusive of all contributory charges except pensions. Of the 16,800 square miles in Buganda, 58 per cent. of this Mailo Survey has been finished since 1904, at the average rate of 430 square miles per annum. In Toro, 88 per cent. of the area of 376 square miles covered by the Toro Agreement of 1900 has been completed. Here the component areas are not contiguous, so that the inclusive field cost of the work amounted to £24 per square mile, while the boundaries and ties showed a cost rate of £5 7*s.* 0*d.* per mile run, included in the square mileage cost aforesaid.

Computations.—Since the whole internal survey of the Protectorate is based on the Clarke 1858 figure, the Arc of Meridian—calculated throughout the Southern Continent on the Clarke 1880 figure—was recomputed on the 1858 figure. The Department is now faced with the question of adjusting its chains of triangulation and is making a proper study of the closures. The trigonometrical measures of altitude are showing fairly good results, such as an average error of $\frac{1}{2}$ inch per mile. The 94 miles of traverse from Mjanji to Bugondo were adjusted to the trigonometrical controls ; it would be interesting to compare the closures of these ruling traverses with those in the Federated Malay States and Gold Coast.

Mapping.—A new map of the Western Province, at the scale 2/M, was sent to England for reproduction. A new map of the whole Protectorate on this scale will now be undertaken ; further, the map will also be reproduced on the scale of 1/M, to meet growing needs.

Land Office and Mines.—The work here involves official conveyancing, registration and issue of prospecting licenses. Tin has been discovered and the first shipment of cassiterite was made in this year.

ANNEX.

The following is an analysis by the Colonial Survey Committee of the Report of the Survey Department of the Anglo-Egyptian Sudan for the year 1928 :—

Anglo-Egyptian Sudan, 1928.

Governor-General.—Sir John Maffey, K.C.V.O., C.S.I., C.I.E.

Director of Surveys.—Colonel S. L. Milligan, C.M.G., D.S.O.

1. *General.*—No important new work was initiated, but good progress was made with various surveys already in hand at the beginning of the year. The Director of Surveys reports a lack of technical skill and supervising power amongst the Native Province Surveyors, which has thrown a good deal of extra instrumental and other work on to the British Inspectors of Surveys. It is hoped to remedy this by special courses of instruction (*vide* paragraph 5).

2. *Triangulation.*—No primary work has been done. The Mongalla Province minor triangulations were continued and two areas together approximating 3,800 square miles were covered. These areas are :—

(*a*) Torit to Taposa.
(*b*) Nimule to Tereteina, along the Sudan-Uganda frontier.

It is hoped to link up (*b*) with the Uganda Triangulation Survey Party's work in 1929.

3. *Topographical.*—(*a*) Information appearing on topographical sheets is obtained largely from outside sources, such as administrative officials and travellers. The most important additions to topographical knowledge of the country in 1928 are provided by the journey of Messrs. Newbold and Shaw in the South Libyan Desert.

(*b*) *Aerial Surveys.*—A few experimental photographs of cultivated and forest areas were taken with a view to expediting the work of the forestry and agricultural departments. There must be a ground party for cadastral surveys, to point out to the landowner his boundaries, and as yet, aerial survey shows no saving in this direction. For the general topographical map (1/250,000) the ground party necessary for control can map topographical features in sufficient detail, and again aerial survey effects no economy. The work in the Sudd region which is being carried out by the Egyptian Government, however, is expected to provide additional information as to the value of aerial survey for special purposes.

(*c*) *Production of Topographical Maps.*—

1/250,000.—Fourteen new sheets were produced and fourteen new editions of old sheets published.

1/1 M.—Two sheets were completed and published.

1/2 M.—Correction tracings for Sudan, Abyssinia, and Kenya sheets were sent to the G.S.G.S. The Sudan portion of the Bahr-el-Ghazal sheet was recompiled, redrawn, and sent to the G.S.G.S. for incorporation in the new edition of that sheet.

1/3 M.—Corrections were sent to England.

In addition to the above, 47 special drawings were made.

4. *Cadastral Survey.*—

1/20,000.—56 sheets of the contoured map of Gezira were produced.

1/50,000.—13 sheets were reduced from the 1/20,000 and redrawn for publication.

1/100,000.—2 sheets were published.

Much miscellaneous land survey work has been done, mainly for the Departments of Lands, Agriculture, and Irrigation. Amongst many town surveys, the survey of Omdurman is nearing completion and the revision of Khartoum is to be undertaken shortly.

5. *Survey School.*—A scheme for a series of post-graduate courses for Gordon College graduates and other junior members of the Department has been submitted. A Summer School of Instruction was instituted and was attended voluntarily by 29 officials. Twenty-five candidates out of forty-two passed the Efficiency Bar Examinations, whilst nine passed the Senior and fourteen the Junior Examinations.

6. *Printing and Mapping Section.*—During the year 13,492 sheets of value £1,823 were issued ; 175 plates were prepared for printing, making a complete stock of 788 plates.

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Report. [Cmd. 2387.] 3*s.* 6*d.* (3*s.* 9*d.*).

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Report by the Hon. W. G. A. Ormsby Gore, M.P., on his visit during the year 1926. [Cmd. 2744.] 3*s.* 6*d.* (3*s.* 9*d.*).

IMPERIAL CONFERENCE, 1926.
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Colonial Survey Committee

1929.

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COLONIAL SURVEY COMMITTEE REPORT 1929.

The Report reviews survey work done during the years 1928 *and* 1929, *or, in the case of Survey Departments whose departmental year ends on the* 31*st March, the years to* 31*st March,* 1929, *and* 31*st March,* 1930. *In some cases the year* 1928 *or* 1928–29 *has been reviewed in the previous report; in others the reports for* 1929 *or* 1929–30 *have not arrived in time for inclusion in this review.*

The following Report of the Colonial Survey Committee has been submitted to and approved by the Secretary of State for the Colonies.

W. C. BOTTOMLEY,
Chairman.

H. P. DOUGLAS,
Rear-Admiral and Hydrographer of the Navy.

E. M. JACK,
Brigadier.

H. St. WINTERBOTHAM,
Brigadier and D.G.O.S.

M. N. MACLEOD,
Colonel, General Staff, War Office.

G. T. McCaw,
E. B. Bowyer, } *Secretaries.*

November, 1930.

COLONIAL SURVEY REPORTS.

British Honduras, 1928-29.

Governor.—Major Sir J. A. BURDON, K.B.E., C.M.G.
Surveyor-General.—Mr. F. W. BRUNTON.

Staff.—Five surveyors and seven other officials.

Triangulation.—The reconnaissance and beaconing of the base extension figure near Garbutt's Falls was completed. In the completion of the chain between Garbutt's Falls and Manatee, ten major stations were reconnoitred and beaconed. Nine stations in this chain have been occupied for observations.

Agreement was reached with regard to the siting of the terminal boundary pillars of the southern portion of the British Honduras—Guatemalan boundary. The pillars have been erected near Garbutt's Falls and Gracias a Dios rapids. When these terminals have been connected by triangulation, it is intended to clear the boundary.

Topography.—No topography has been carried out other than that included under the heading of "Cadastral Surveys."

Cadastral Surveys.—The clearing of the northern portion of the western Frontier from Garbutt's Falls to the Guatemala-Mexico boundary has been completed.

The re-survey of the towns of Punta Gorda and Barranco was undertaken and finished.

The opportunity was taken, in surveying the boundaries of the Commerce Bight Estate, to extend the work to fix the mouth of the Sittee River.

In the survey of about twenty-one miles of estate boundaries on the Belize River, nine miles of traverses were run.

The extension of the Burdon Canal near Belize was surveyed and marked out. The digging has now been completed and the canal is open to traffic.

During the year, surveys of various leases, estates, and grants of land were executed.

Ceylon, 1929.

Governor.—Sir HERBERT J. STANLEY, K.C.M.G.
Surveyor-General.—Mr. A. H. G. DAWSON.

Organization of Survey Department.—

Field	...	12 Superintendents of Surveys. 40 Assistant Superintendents of Surveys. 320 Grade Surveyors.
Office	...	3 Assistant Superintendents. 1 Superintendent of Instrument Department. 1 Accountant. 450 Clerks and Draughtsmen.

Observatory... { 1 Superintendent.
1 Astronomer.
4 Technical Assistants.

Topographical Work.—1,527 sq. miles were revised at a cost of Rs.12·71 per sq. mile.

Triangulation.—Only local work of a minor order was carried out.

Levelling.—The lines levelled in 1929 amount to about 726 miles in length. In addition, the lines from Anuradhapura to Trincomalee levelled in 1928 were relevelled.

The levelling in the Northern Area amounted to about 402 miles, with 63 miles of relevelling. The season was exceptionally wet and, although much of the levelling presented no difficulties, the levelling of the coast route was carried through wild country.

In the Southern Area the levelling extended to some 324 miles. In the course of the year's work levels had to be carried across three ferries where crossings were too wide to admit of ordinary methods of levelling. Two of these were crossed by long equal sight observations with 21-inch levels and the other by means of simultaneous reciprocal observations with 21-inch levels. No extraordinary errors seem to have resulted.

The proportion of levelling found necessary due to discrepancies was 13 per cent. during the year.

The year's work completed the levelling of the main net started in 1926, the whole length of the lines of which is roughly 2,400 miles.

During recess periods misclosures were worked out, and although in nine circuits differences of height exceeding 1,000 feet occurred the misclosures were not generally greater than in flat circuits.

Tidal Observations.—Tidal observations were carried out daily at Trincomalee and Colombo, and records of actual times and heights of high and low water were supplied to the Director, Geodetic Branch, Survey of India, for comparison with predicted times and heights.

Cost of Work.—The "field" cost per double levelled mile was Rs.79·87, the corresponding figure in 1928 being Rs.89, in 1927 Rs.95, and in 1926 Rs.100. This constantly decreasing cost per mile has been due to increased yearly outputs.

Block Survey.—The total area block surveyed during the year was 97,270 acres at a total cost of Rs.577,459, or Rs.5.94 cts. per acre. This includes 29 acres of insets on the scale of 4 chains to 1 in.

The average number of Surveyors employed on Block and Settlement Surveys during the year was 145 Surveyors and 14 Assistant Superintendents of Survey.

Plan Work.—Plans covering a total area of 137,488 acres were issued to the Settlement Officer during the year. Various Town Planning and assessment surveys were completed during the year.

Application and Miscellaneous Surveys.—The requests for these surveys showed a decrease of 1,234 since 1928, which is due to the new " mapping out " policy. The extent surveyed covered an area of 33,372 acres in 19,132 lots at a cost including supervision of Rs.22 per acre.

Classes.—The normal surveyors' classes were held throughout the year. Two Survey Probationers went to Cambridge University for a course of training.

Expenditure.—The total expenditure for the calendar year 1929 amounted to Rs.39,05,346.02.

Cyprus, 1928-29.

Commissioner.—Colonel Sir RONALD STORRS, K.C.M.G., C.B.E.
Director.—Mr. B. T. WATTS, O.B.E.

Organization and Staff.—The Department is divided into three sections, viz. :—

(i) The Survey Branch, consisting of one 1st Grade Surveyor, two 2nd Grade Surveyors and 50 other employees of various grades in the field, and 30 employees in the office.

(ii) The Valuation Branch with a staff of 6.

(iii) The General Registration Branch with a staff of 35. Some of the above are temporary.

Expenditure.—The total expenditure for the three branches amounted to £14,291 6*s.* 4*d.*

Receipts from the sale of maps amounted to £262 8*s.* 8*d.*

Survey Work :—

(*a*) Plane table work was completed over an area of 25,960 acres on a scale of 1/5,000 and an area of 27 sq. miles of contour survey in the Morphou Bay Area.

(*b*) An area of 1,084 acres in Limassol Town was surveyed, and the survey of Nicosia Town on a scale of 1/1,500 was completed.

Some traverse and survey work was also done in the towns of Kitma, Famagusta, and Varosha, an area of 1,542 acres on a scale of 1/1,000 being completed in the two latter towns. Plots over an area of 21 acres were laid out at Platres.

(*c*) Railway Extension Survey. An area of 195 acres on a scale of 1/2,500 between the mouth of the Xeros River and Mavrovouni Mine was completed.

Office Work.—In addition to the usual work of computation, etc., an area of 985 sq. miles was reduced to smaller scales from the 1/5,000 plans.

153 plans were plotted and 129 clean-drawn on various scales. 4,020 sun-prints of plans were made.

Valuation Branch.—This Branch proceeded with the work of valuation in the Nicosia and various other districts, dealing with an area of 32,548 acres. The revaluation of the Island, started in 1909, has now been completed.

The cost of this branch was £1,845.

General Registration Branch.—This branch dealt with the registration of holdings over an area of 28,109 acres. Registration fees collected amounted to £1,778.

Federated Malay States, 1928.

High Commissioner.—Sir HUGH CLIFFORD, G.C.M.G., G.B.E.

Surveyor-General.—Mr. V. A. LOWINGER.

Staff.—The authorised establishment was 74 senior officials and 757 clerks and subordinates.

Finance.—The net cost of the Department was $1,182,322* as against $1,054,378 in the preceding year. Nearly 50 per cent. of this total is on account of the Revenue Survey Branch.

Progress of Revenue Surveys.—There was no increase in arrears except in respect of native holdings.

Triangulation.—The only triangulation undertaken was that required for the preparation of three Standard 1-inch sheets in Pahang.

Topography.—The report of this branch of the work is given in considerable detail. The total area surveyed for the Standard 1-inch to 1 mile map was 1,706 square miles. The cost per sq. mile was reduced (to $128 in the case of Pahang sheet) and the season appears to have been a most satisfactory one.

Map Production.—The work produced by the Photo-Litho section has maintained the same high standard and the demand for maps in the Federated Malay States is stated to be increasing continually. The good quality of the maps produced was the subject of comment at the Empire Mapping Exhibition held in London in 1928.

Meteorology.—Nine out of seventeen "second order stations" have been established and have commenced observations, and the remaining eight should be at work by the end of the year.

* $ = 2s. 4d.

Federated Malay States, 1929.

High Commissioner.—Sir HUGH CLIFFORD, G.C.M.G., G.B.E.

Surveyor-General.—Mr. V. A. LOWINGER.

Staff.—The authorised establishment was 90 senior officers and 769 clerks and subordinates.

Finance.—The net expenditure, after deducting reimbursements and revenue was $1,229,066, as compared with $1,182,322 for 1928.

Progress.—The demand for surveys continued to increase, the great majority being for native holdings. The number of requisitions received was 16,455, as against 15,101 in the preceding year.

Topography.—A successful readjustment of duties in the topographical survey of jungle was carried out and the new procedure was to be adopted in 1930.

The cost rate per mile in 1929 was $118 for 1 inch to 1 mile work, as opposed to $[illegible] in 1928.

Map Production.—The revenue derived from the sale of maps showed an increase of 20 per cent. on the previous year. There was an increased output and a wider range of maps. All future maps will be hand lettered instead of typed.

Training.—The results of the annual examinations showed a marked improvement by candidates for subordinate posts.

Fiji, 1928.

Governor.—Sir EYRE HUTSON, K.C.M.G.

Commissioner of Lands.—Mr. C. A. HOLMES.

Staff.—Lands Department : 6 surveyors, 5 draughtsmen, 2 native tracers, 3 clerks. Native Tribal Boundary Survey : 14 Surveyors, 3 native pupil surveyors.

Minor Triangulation Surveys.—The survey of minor stations was extended during the year by the addition of one station in the Province of Rewa, five stations in the Province of Ba, one station in the Province of Ra, eight stations in the Province of Colo North, four stations in the Province of Colo East, and four stations in the Province of Macuata.

The total number of minor trigonometrical stations established by the Lands Department in the Island of Vitilevu (including Ovalau) is now 232 and in Vanualevu 97. Upwards of 50 existing stations were rebeaconed during the year.

Main Traverse Surveys.—The following main traverse surveys were executed during the year :—

	Miles.
New traverses	41
Redefinition of former traverses ...	69
Subsidiary traverses	39
Total	149

Native Tribal Boundaries Surveys.—The reinforcement of the survey staff by the appointment of seven First-Grade men, six of whom were recruited in New Zealand, resulted in a very considerable increase in the acreage surveyed as compared with previous years. The Government decided further to increase the staff in 1929 by three First-Grade surveyors.

The total area surveyed during 1928 amounted to 205,304 acres in 593 lots at a cost of £6,011, being an increase in area of 148,440 acres as compared with 1927. The cost was thus 7d. an acre, the lots averaging 35 acres.

Miscellaneous Surveys.—Various normal miscellaneous surveys were carried out by officers of the Department during the year.

Drawing Office.—The routine work consisted of 1,819 plans, tracings, etc., completed at a cost of £597.

A new map of the Colony on a scale of 20 miles to an inch was published early in the year. This map was drawn in November, 1927; zinc line-blocks were made in Sydney and the map was reproduced by the Fiji Government Printing Office.

Gold Coast, 1928-29.

Governor.—Sir A. RANSFORD SLATER, K.C.M.G., C.B.E.
Surveyor-General.—Mr. J. CLENDINNING, B.Sc., A.M.I.C.E.

Staff.—The staff at the end of the year under review consisted of 45 Europeans and about 200 Africans (including those under instruction).

Trigonometrical Branch.—Two new trigonometrical stations were established and observed, and 263 miles of precise traversing carried out. The methods employed on these traverses were somewhat modified by:—

(*a*) Taping to trunnion of theodolite;
(*b*) laying on zero mark of tape at end distant from theodolite, instead of reading both ends;
(*c*) correction of taped distances for slope by vertical angles instead of by difference of levels;
(*d*) experiments with different lengths of tapes.

The general effect of these modifications was a speeding up of the work with no apparent reduction in accuracy. One party attained a maximum rate of work of 31 miles a month. Misclosures on various trigs., expressed as a fraction of the length of traverse, varied between 1/32,000 and 1/60,000; whilst the closure of the bearings on azimuth stations shewed corrections of from 0·1 to 1·2 seconds only.

In the office, the 1920–21 secondary triangulation has been recomputed and adjusted to the 1924–25 primary chain, with satisfactory results.

Topographical Branch (*Boundary Surveys*).—The International Boundary Survey Party on the western frontier completed its work in June, 1928. Good progress has been made on the Eastern Boundary Survey and it is hoped to complete this side about May, 1929.

Cadastral Branch.—A Special Town Survey Party has been formed and started work on Town Surveys. Much work has also been done in this branch on surveys of land concessions, forage reserves, etc. The five provincial survey sections have been employed on town surveys and lay-outs, and on many miscellaneous tasks.

New Standard of Length—Accra.—A new standard 300 ft. in length, all housed under one roof, has been laid down and promises to be of great value for refined work. For measurements of tapes on the flat, readings can be estimated to 1/10,000 of an inch roughly, whilst for standardizations in catenary vernier readings can be made to ·01 mm. or 4/10,000 of an inch. Experiments are being made to determine periodical changes of length, temperature variations, etc.

Publications.—The Department has produced two publications during the year—*Technical Instructions for the Cadastral Branch*, and *Tables for use in the Department.*

Gold Coast, 1929-30.

Governor.—Sir A. RANSFORD SLATER, K.C.M.G., C.B.E.
Surveyor-General.—Mr. J. CLENDINNING, B.Sc., A.M.I.C.E.

Staff.—The Department was organized as a Headquarters and four branches with two special parties and the Survey School, and includes all told some 260 members, both European and African.

General.—The yearly increase in demands upon and work done by the Department was maintained, though nothing of outstanding importance occurred during the period under review.

Records and Reproduction.—Some idea of the yearly increase in output may be gained by the following table :—

	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.
Output of Maps and Plans.	86,115	121,960	154,250	268,500	403,000

The figure for 1929–30 represents approximately the maximum possible production with the existing equipment.

Besides the normal amount of work for Sierra Leone and for other Departments, fourteen sheets to illustrate the completed survey of the eastern Boundary were drawn and are ready for printing. The special wall map of West Africa, on a scale of 1/500,000 was to be finished in June, 1930. In addition to reprints of the

standard topographical sheets, ninety-eight town plans were printed in consequence of the decision that, owing to the unforseen demand for such plans, it would be cheaper in the long run to print all of them.

The Survey School.—Three pupils qualified as surveyors at the examination held in March, 1930, while out of 291 candidates at the entrance examination in October, 1929, thirteen were selected. The number of pupils now undergoing the three years' training entailed by the course is thirty-seven. Excellent reports have been received from surveyors in charge of ex-pupils working in the field.

Cadastral Branch.—This branch comprises the following :—

(*a*) Drawing Office. Besides other routine work, forty-five Town Survey Sheets and a map of the Municipality of Accra on a scale of 1/12,500 were drawn.

(*b*) Examination and Checking Branch. Thirty-six tapes were standardized and 180 sets of computations checked.

(*c*) Provincial Survey Sections. Eastern, Central, Western, Ashanti, and Accra Provinces. These Sections have all been fully occupied in the survey of townships, acquisition, exchanges, and leases of land, and local boundary disputes, in tying in their own work to the Colony Framework, and in various minor triangulations for purposes of extension.

(*d*) Forest Reserve Boundaries—Special Party.—This party is split into two halves.—No. 1 Party completed the Bandai Hills and Yaya Reserves and made good progress with the Bosomoa Reserve in the Kintampo district. No. 2 Party completed the survey of three Reserves in the Central Province and has made good progress with others, though hampered by the attitude of the Asyum people, with whom friction arose.

(*e*) Special Town Survey Party.—On the completion of the survey of nine towns the party was split up into three sections working in the Central, Western, and Ashanti Provinces respectively. These parties have surveyed two towns and nearly finished with Salt Pond and Anwiawso, while the complete resurvey of Kumasi is in hand.

Trigonometrical Branch.—A new chain of Primary Triangulation was reconnoitred and beaconed from Akuse to Kete Krachi. This chain, running north along the Meridian of Greenwich, involved the siting of fifteen new primary points. The survey was to be begun in April, 1930. The cost per station of reconnaissance, clearing and beaconing, averaged £82 per station, indicating more than ordinary difficulties.

One new secondary and seven tertiary points were fixed during the year.

No. II Primary Traverse, running roughly from Apam to Takoradi, was with some difficulty tied to the main framework near Sekondi.

The distance covered by Primary Traverses during the year fell a good deal short of the intended programme owing to casualties in personnel and priority work mentioned above ; in all 73 miles were traversed.

The completion during the year of the Eastern Boundary Survey finished all work contemplated on the International Boundaries.

Topographical Branch.—On the completion of the Accra and Koforidua sheets the survey of the Afram Standard Sheet and of that portion of the H.O. Sheet which lies to the west of the River Volta was undertaken. It was hoped to finish this latter work by May, 1930, when the mapping of the Colony up to the 7° North parallel would be complete. During the year an area of 1,156 sq. miles was revised. The total area of new survey in hand at the end of March, 1930, was 2,020 sq. miles. The average cost of revision per sq. mile was £1 17*s.* 3*d.* for the field work ; this cost was increased to £2 12*s.* 2*d.* per square mile by the expense of Topographical Headquarters and supervision. Though apparently high, these costs include a good deal of extra work put in to improve the representation of hill features and small rivers. Moreover, 30 per cent. of the area covered was mountainous and difficult.

Statistics :—

(*a*) *Topographical.*—For the revision of the standard (1/125,000) sheets, the average number of miles of traverse was increased from 1.6 to 3.4 miles per sq. mile. The average output per man-day was 0.66 sq. miles of detail or 2.2 miles of traverse.

(*b*) *Cadastral.*—The average field cost of theodolite traverses was £31 per mile, varying from £11 to £38 ; this cost included all charges except pensions, passages, rail transport, and depreciation, and the work was executed in rugged forest country. Compass traverses in the same country cost from £4 to £8, averaging £5 12*s.* per mile run.

(*c*) *Primary traverses* showed a field cost varying from £27 per mile under adverse conditions to £10 on motor roads.

(*d*) *Boundary Topography* of 2,048 sq. miles on the Togoland frontier showed a field cost of £1 8*s.* per sq. mile.

(*e*) *Town Surveys* levelling cost from £1 17*s.* to £6 per mile run. Theodolite traverses here cost from £4 10*s.* to £7 for observation and £12 to £21 for clearing per mile. The cost of detail work varied from 8*s.* to 30*s.* per acre, and the drawing thereof from 3*s.* to 37*s.* per acre, according as the work was open or close.

Hong Kong, 1928-29.

Governor.—Sir C. CLEMENTI, K.C.M.G.
Superintendent of Surveys.—Mr. E. B. REED, P.A.S.I.

Finance.—The net cost of the Department, exclusive of office costs of light, heat, fans, etc., was $166,688* as against $153,000 in the previous year.

Personnel.—The personnel, consisting of 11 Europeans and 27 Chinese, exclusive of coolies, remained the same as for the previous year.

Triangulation.—No work of any importance was undertaken during the year. Eight beacons were erected and a number of points visited and reported on. The maintenance of triangulation stations is an important work, which should on no account be overlooked.

Revenue Survey.—Some 294 acres were surveyed in the course of the year, and a good deal of departmental work for the Police, etc., was prepared. Numerous mirror surveys of plots, villages, etc., based on traverses with closures of from 1/5,000 to 1/10,000 were carried out. Under the heading "Survey of Colony" details of some 573 acres are recorded, of which 434 acres were in respect of the Golf Course and Race Course.

Maps.—A 1/10,000 sheet covering Victoria Harbour will be published at the end of 1929.

The large-scale plans of Victoria City, scale 160 feet to 1 inch, appear to stand in need of extensive revision or entire replacement.

Adjustment of Triangulation.—The compensation of the main triangulation, by the method of least squares, was issued by the War Office during the year. The computation of the co-ordinates will follow.

Jamaica, 1928.

Governor.—Sir R. E. STUBBS, G.C.M.G.
Surveyor-General.—W. ANTHONY BAKER, F.R.G.S., F.S.I.

The Department is charged with the administration of the Crown Lands, containing some 280,000 acres, and is primarily a Lands Department, there being no Survey Department in the strict sense of the name.

The Staff of the Department consisted of the Surveyor-General, the Assistant Surveyor-General, 2 surveyors, 1 draughtsman, and a clerical staff of 5.

The field work of the Department was devoted to cadastral surveys throughout the year, covering an aggregate of some 91 miles of traverse work at degrees of accuracy ranging between 1/400 and 1/4,000. The average cost per mile was £6 18*s.* and the daily rate 45 chains.

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* $ = very approximately, 2s. 0d. during the year.

The main work, however, was done in the office in relation to sales, leases and tenancies, forfeiture of land, and preparation and checking of plans for registration of titles. This branch of the work had been trebled since 1914, and the steady increase which has occurred, year by year, since that date was still maintained.

Kenya, 1928.

Governor.—Lieutenant-Colonel Sir E. W. M. GRIGG, K.C.M.G., K.C.V.O., D.S.O., M.C.
Surveyor-General.—Mr. A. G. BAKER.

General and Staff.—On 31st December, 1927, the Land Department was dissolved and the post of Deputy Registrar of Titles abolished. The Survey and Registration Divisions were amalgamated under the control of a Surveyor-General. The following was the authorized staff:—Central Office, 6; Survey Section, 44; Registration Section, 19.

A post of Assistant Surveyor-General was created, and two Staff Surveyors added to the establishment for the primary purpose of expediting the demarcation of the Native Reserve boundaries. A new post of Office Superintendent was made, this Officer to control the collection of Revenue and supervise the clerical work of the Head Office. Temporary clerical staff had to be engaged. Only one of the surveyor's posts was filled as difficulty was experienced in finding applicants. It was hoped that applicants might be found in New Zealand.

The continued progress of the survey cadets justified the experiment of engaging local youths.

Revenue and Expenditure:—

	£
Original Estimate of Revenue	75,560
Revised ,, ,, ...	69,270
Collected Revenue	57,342

The revenue showed a decrease of £4,000 on the year 1927. This decrease was due to depression in real estate market caused by the drought and invasion of locusts and the fact that the Government auctioned little Crown land during the year.

Total Expenditure £35,462

This cannot be compared with former years owing to the reorganization of the Department.

Survey Division.—District Surveyors were maintained at Nairobi, Mombasa, Nakuru, Eldoret, and Nyeri.

(*a*) Nairobi.—Miscellaneous surveys of Crown land in the area of Nairobi Town Planning Scheme were carried out, the surveys of licensed surveyors practising in the district were checked, and work was done on the demarcation of the Fort Hall and Kiambu Native Reserves.

(*b*) Mombasa.—Licensed surveyors working under the District Surveyor finished the survey of new plots created by the Town Planning Scheme and survey of improvements is well advanced. The District Surveyor represented the Town Planning Authority in all cases of compensation under the Scheme. The valuation roll of the unimproved site value of all land in the Island was completed by two licensed surveyors and the District Surveyor.

(*c*) Nakuru.—The District Surveyor was mainly employed on Township work and designs were prepared for portions of Nakuru and Njoro and for the replanning of the old bazaar area at Kisumu.

Plots were surveyed for purposes of alienation at Elburgon, Molo, Kisii, Kisumu, Njoro, Nakuru, Naivasha, and Gilgil.

An important section of the boundary between the Masai and South Kavirondo Native Reserves was demarcated at the request of the Chief Native Commissioner as trouble was brewing over certain springs.

The District Surveyor nearly finished the valuation roll of the land and improvements in Nakuru.

(*d*) Eldoret.—A resurvey of Eldoret Township was carried out. The surveys of both Eldoret and Kitale Townships are now up-to-date. The District Surveyor was also employed on checking the licensed surveyors' work and preparing valuation rolls for Kitale, Eldoret, and townships adjoining them.

(*e*) Nyeri.—Township plots were surveyed at Rumuruti and at Nyeri Station, and a design was prepared for a small township at Narro Moru. Surveys and valuations were made of farms included in the Laikipia Extension Scheme, and a portion of the boundary between the Fort Hall and Nyeri Native Reserves was demarcated.

Topographical Surveys.—Attention was drawn to the fact that the topographical maps of the country were out-of-date and that revision was desirable, but the financial position prevented the engagement of the necessary staff. A rapid topographical reconnaissance of the Lorogi Plateau, 600 sq. miles in extent, was carried out, and a start was made with the topographical survey of the Nairobi Municipal Area.

Demarcation of Native Reserve Boundaries.—This work was divided into four groups and undertaken by the following Departments: Administration, Forest Department, Survey Department, and Tanganyika Territory Boundary. Of the 3,145 miles to be surveyed 1,000 miles have now been completed. The cost of this work to the Survey Department was slightly below the estimate of £10 per mile.

Valuation.—Valuation rolls for rating purposes were prepared in Mombasa, Nakuru, Eldoret, and Kitale.

Licensed Surveyors.—There were fifteen licensed surveyors of whom twelve were practising regularly. The demand for surveys was steady throughout the Colony.

Computing Office.—The staff on paper consisted of nine computers and one junior computer, but for various reasons the effective strength of the staff amounted to six computers for the year. The total number of areas checked was 1,445.

Drawing Office.—The staff was employed on the production of the following :—General Office Maps, maps for illustration purposes of other Departments, deed plans, 1/2,500 plans of Nairobi, township maps and maps of Local Government areas. The brochure of the general areas of the Colony of Kenya was brought up to date, work has been done on the description of boundaries, and complete new descriptions of all forest reserves are nearing completion ; it was hoped to gazette them in 1929.

Public Map and Record Office.—The annual return of work shews an increase.

Surveys received and registered from 1st January to 31st December, 1928 :—

Government Surveys	414,961 Acres.
Demarcation Surveys of Native Reserves ...	205 Miles.
Coast-Land Surveys	1,185 Acres
Surveys by licensed surveyors	121,524 ,,
Deed and Agreement Plans	1,328 ,,

8,894 plans, plus 13 sets of deed plans, were issued during the year. The total value of sales of maps, including deed plans, was Sh. 10,578.50, and the value of issues to Government Departments Sh. 24,103.70.

Registration Division.—There was a slight decrease in revenue which was due to a smaller number of Crown grants being registered. Apart from this the volume of business had not diminished. Despite considerable sickness the average time for registration of documents was five days. The work of registry was substantially increased owing to the provisions of the Local Government (Municipalities) Ordinance, 1928, and the Local Government (District Councils) Ordinance, 1928.

Stamp Duties.—The decrease of revenue was attributable mainly to the falling off in transfers of high value.

Over-embossing system.—The system worked smoothly during the year under review. The number of bills of exchange, etc., dealt with was 125,633, and in view of the small cost involved the system is justified and effectively prevents leakage of revenue.

Conveyancing.—The revenue under this head amounted to £1,072 ; a decrease of £992 from the previous year is accounted for by less Crown land being alienated. New substituted titles for Mombasa properties were issued.

Recorder of Titles.—The Registrar of Titles, Mombasa, acted in this capacity.

Revenue.—The revenue collected under the Land Titles Ordinance, 1928, amounted to Sh.25,682.25.

Land Registration Court.—About 100 cases were dealt with, including those in which orders were made, judgments amended, and final awards given. One hundred and thirty-one certificates of ownership were taken up by plot holders. Completed titles held in custody at the end of the year pending delivery amounted to about 2,400.

Claims in the following areas were still pending survey and adjudication :—

Lamu	1,293
Malindi, Takaungu and Kilifi	2,000
Vanga Township	949

There were several privately-owned shambas lying within the Mazrui Blocks 1, 2, 3, 4 and 5 still waiting survey and adjudication.

Nigeria, 1928.

Governor.—Sir GRAEME THOMSON, G.C.M.G., K.C.B.
Surveyor-General.—Captain T. J. WATERS, R.E.

Staff.—The nominal roll contained 42 Surveyors and 4 officials on the Headquarters Staff. There were in addition special parties as follows :—

Special Royal Engineer Party—Topographical Survey	6 Officers. 6 N.C.Os.
Special Royal Engineer Party—Minesfield Survey	5 Officers. 18 N.C.Os.

Triangulation.—(1) Eruwa-Minna Series. The observation of this chain was completed early in November in spite of many difficulties.

Number of major stations occupied	20
Number of minor stations occupied	1
Number of points re-occupied...	7

Total cost per station—£48 10*s.*

(2) Udi-Lokoja-Abuja Series. The reconnaissance and beaconing was completed. This entailed the erection of four tree stations varying between 80 and 173 feet in height. Violent storms wrecked the highest of these on three occasions. This, and the heavy clearing necessary owing to the flat nature of the country, seriously hindered the observing. Nevertheless a junction was effected with the Eruwa-Minna Chain and observations were completed at three stations ; this included all observations to and from the 173-ft. tree station.

The expense of reconnaissance and beaconing per station was approximately £85, the cost showing clearly the difficulties incidental to the work.

(3) Primary triangulation on the Bauchi Plateau and in the North and South Mada Districts did not give sufficient control for the mines field survey. A close framework was therefore established by two Royal Engineer parties in the field. This work, begun late in 1927, was completed in 1928, and a large number of tertiary points provided.

(4) A new base line was measured near Minna with a probable error of 1/656,000. The azimuth of this line was also determined.

Traverses.—The cadastral framework traverse from Lagos to Abeokuta, interrupted in 1927 by sickness, was completed.

Topography.—The work begun in 1927 by the Royal Engineer parties was continued. Three standard sheets of the 1/125,000, each covering 960 sq. miles, were published. The reconnaissance and beaconing for one sheet was completed, whilst considerable progress was made in the case of another.

Six other sheets were compiled and printed in addition.

Cadastral.—Southern Provinces. Much work was done in traversing areas near Lagos in addition to a quantity of original and revision work on a scale of 88 ft. to 1 in., and the survey of layouts, roads, etc., in the district.

Investigation of titles and surveys of acquisitions were also carried out for the Government.

The survey, drawing, and reproduction of the town plans of Ibadan, Abeokuta, and Energue made good progress. At the end of the year the complete series of forty-three sheets of Ibadan on a scale of 400 ft. to 1 in. were almost ready to be put on sale.

The drawing office had still more work than it could handle. Nearly £1,800 was recovered in fees.

Northern Provinces.—Minesfield Division. At the close of the year the mining areas awaiting survey totalled 136 as against 235 at the close of 1927. The minesfield however had been closed for prospecting for six months in order that the Royal Engineer Minesfield party might be liberated for the completion of the triangulation on the plateau.

The total fees earned by Government and Royal Engineer Minesfield parties for the survey of leases amounted approximately to £12,500.

Township Plans.—The layouts of eighteen townships were prepared and approved.

Survey School.—The School proved more successful even than was anticipated and is turning out a good type of well trained African surveyor. There were twenty-two pupils in the School at the close of the year.

General.—The department was heavily occupied in work of a nature so varied that it is difficult to summarize its activities briefly.

Northern Rhodesia, 1929.

Governor.—Sir J. C. MAXWELL, K.C.M.G., K.B.E., M.D.

Director of Surveys.—Mr. W. G. FAIRWEATHER, B.Sc., A.M.I.C.E.

1. *Staff.*—Besides the Director and Deputy Director, the Department included 10 European surveyors with 8 natives. Headquarters is at Livingstone and there are 4 District Sub-Offices. The Department was short handed during the year and also handicapped by lack of accommodation, though both these disadvantages were being remedied.

2. *Headquarters.*—Headquarters were kept so busy with routine work that little new work or revision was possible. Nevertheless, five sheets of 1/250,000 Series were redrawn and printed. Owing to an influx of licensed private surveyors, as a result of the mining activity, a code of rules and regulations had to be drawn up to control and facilitate the checking and co-ordination of methods of survey.

3. *District Sub-Offices.*—(*a*) Fort Jameson: One Assistant Surveyor, one Chain Boy. The resurvey of the township of Fort Jameson was begun and will be completed in 1930.

(*b*) Lusaka: 1 District Surveyor, 1 Chain Boy. Surveys of farms in Chisamba and East Lusaka farming districts were carried out and minor plot surveys in and around Lusaka.

(*c*) Kasama: 1 District Surveyor, 1 Assistant Surveyor, 1 Chain Boy. The survey of the township of Abercorn was completed and a large number of the farm sub-divisions of the British South Africa Company's Estate of Tanganyika were finally surveyed.

(*d*) N'Dola: 1 District Surveyor, 1 Assistant Surveyor, 2 Chain Boys. This Office was opened during the year. It will be an important station, being the centre of the mining activity. The survey of the township of N'Dola is in progress and the work will probably consist of surveys of townships and town expansions for some years to come.

4. *Air Surveys.*—The aerial survey of the Zambesi River and of its tributaries, the Lungwebunga and the Kabompo, and the area of the Rhodesian-Congo border concession were completed. This work is proving its value. The cost for the 1,241 sq. miles surveyed was £7,025.

Further contracts were arranged covering an area of approximately 63,450 sq. miles. The work entailed is designed to be completed by the end of 1931.

Nyasaland, 1929.

Governor. { Sir CHARLES BOWRING, K.C.M.G., K.B.E.
Mr. T. S. W. THOMAS, C.M.G., O.B.E. (from November).

Lands Officer.—Mr. J. E. ALEXANDER.

Staff.—4 Surveyors, 1 Lands Assistant, 1 Native Tracer, 3 Native Clerks.

Trigonometrical and Topographical Survey.—Nil.

Cadastral Survey.—The whole of the field work involved the measurement of 49 discontiguous blocks, totalling 12,650 acres.

Palestine, 1929.

High Commissioner.—Lieutenant-Colonel Sir J. R. CHANCELLOR, G.C.M.G., G.C.V.O., D.S.O.

Director of Surveys.—Major C. H. LEY, O.B.E.

Staff.—The staff included, in all, 53 in the office and 65 in the field, of whom 50 per cent. were not yet fully trained.

Triangulation.—The sides of the principal triangles enclosing Beersheba were broken down by 3rd-order chains containing 24 points in an area of 112 sq. kms.

The following areas were covered during the year with a network of points :—

Topocadastral	...	...	339 sq. kms., 112 points.
4th-order triangulation	...	...	858 sq. kms., 1,614 points.

In addition, 96 kms. of traverses were run by town survey parties, comprising 1,062 stations, bringing the total number up to 18,402 stations covering 7,700 sq. kms.

MISCELLANEOUS OBSERVATIONS.

Magnetic Variation.—The mean declination on the coastal plain in December worked out at 1° 15′ East.

Diurnal variation of Pressure.—Aneroid heights on the coastal plain were found to be subject to a diurnal variation of as much as 15 metres per hour, with the maximum reading at the hottest part of the day.

DETAIL SURVEYS.

Topocadastral Surveys.—During the year 745,700 dunams* on the plain of Esdraëlon were mapped at an average cost of 3.4 mils* per dunam, while 358,190 dunams in the Gaza district were revised at an average of 1.2 mils per dunam.

Town Surveys.—The cost of town surveys during the year averaged 696 mils per dunam, including 126 mils for examination. The towns of Nablus, Tiberias, Acre, and Nazareth were completed ; Safed and Bethlehem were under examination and Beit Jala, Beersheba, and Jericho were begun.

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* 1 Metric dunam = 1,000 square metres = ·2471 acre. 1 mil = ·24d. 20 mils per dunam = 1s. 7½d. per acre.

Cadastral.—A change in procedure by which the Survey Department undertook the demarcation of claims to divided land caused the strength of the cadastral party to be more than doubled. Some 74,000 dunams of the Beisan lands were dealt with, while on the Maritime Plain, besides the completion of 172,621 dunams, a start was made with 45 blocks in five different villages.

In agricultural lands the average cost was about 14.5 mils per dunam, but in areas where small irregular houses had been built without plan, the average was as much as 738.5 mils per dunam for Arab villages.

Map Production.—Ten sheets of the 1/20,000 topocadastral series have now been published. In addition the following special maps are now obtainable :—

1/10,000 Haifa and Mount Carmel, contoured, in 2 colours.

1/250,000 general map in two sheets, with forest areas, in five colours.

1/20,000 Pethah Tiqva, topocadastral with overprinted pedology in six colours.

Various defence maps, survey plans, and land registry plans were also produced during the year.

Health.—The health of the staff was good. During the year 1,607 man-days were lost owing mainly to malaria amongst the field parties.

Sierra Leone, 1928.

Governor.—Brigadier-General Sir J. A. Byrne, K.C.M.G., K.B.E., C.B.

Director of Surveys.—Major J. Dare, M.C.

Staff.—The Staff consisted normally of 9 Europeans, 14 qualified Africans, and 35 African pupils and apprentices.

Topographical Branch :—

(*a*) *Horizontal and vertical frameworks.*—Seventeen astronomical and wireless fixings were made, bringing the total up to sixty-nine. It was estimated that a further fifty fixings would be required.

235 , of topographical levelling were carried out, and it was hoped to finish the vertical framework of the Protectorate by June, 1929.

(*b*) *Detail Survey.*—During 1927–8 about 7,500 sq. miles of country was surveyed, mainly by means of compass traverse and aneroid levels. Nineteen 1-in. sheets were completely surveyed, at a cost, exclusive of framework, reproduction and overhead charges, of £1 per sq. mile. The future programme envisages completion of the 1-in. survey in June, 1930. Topographical information was supplied to political offices and to public works and railway companies.

Cadastral Branch.—The main item of interest for this section was the lay-out of the platinum and gold areas into rectangular blocks, mostly of 2 sq. miles each. A few minor surveys and lay-outs were also made.

Miscellaneous.—The Lands Branch carried out the usual routine work in connection with Crown Lands and other properties.

Twenty-four pupils continued under training at the Survey School.

Straits Settlements, 1928.

Governor.—Sir HUGH CLIFFORD, G.C.M.G., G.B.E.
Surveyor-General.—Mr. V. A. LOWINGER.

Authorised establishment.—11 Surveyors, 165 technical subordinates and apprentices, 1 clerk and storekeeper, and 9 peons.

Finance.—The expenditure during the year remained at almost the same figure as in 1927; the revenue, however, increased by some $16,000.*

Map Production.—The chief feature of the year was the production of a 4-in. to 1-mile Topographical map of Penang, a map of the highest quality reflecting great credit on the Department.

Progress of Revenue Surveys.—The output increased largely but was still unable to keep pace with the demand, owing to shortage of trained subordinates. The Technical School at Kuala Lumpur was, however, effective throughout the year and the position should show steady improvement.

Meteorology.—The sites for the new Stations in Singapore and Malacca were selected and it was anticipated that they would be in full working order by April, 1929.

Straits Settlements, 1929.

Governor.—Sir HUGH CLIFFORD, G.C.M.G., G.B.E.
Surveyor-General.—Mr. V. A. LOWINGER.

Authorised establishment.—11 Surveyors, 185 technical subordinates and apprentices, 1 clerk and storekeeper, and 9 peons.

Finance.—The Revenue amounted to $148,461, showing an increase of $38,000 approximately over 1928, whilst expenditure totalled $505,286, showing a decrease of nearly $4,000.

The Revisionary Survey of Malacca, to be completed in 1931, accounted for $123,000 of this sum.

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* $ = 2s. 4d.

Requisitions.—These, with a total of 5,699, show a decrease of 992 lots. 8,092 lots were surveyed against requisitions. The reduction of arrears was proceeding rapidly, and the situation was rapidly becoming satisfactory.

Meteorology.—Fourteen out of the seventeen stations listed in the Malaya programme were established and the remainder in hand at the end of the year.

Map Production.—A map of Penang Island, at a scale of 1 in. = 1 mile, part of the standard topographical series of Malaya, was published during the year.

Trinidad and Tobago, 1928.

Governor.—Sir HORACE A. BYATT, K.C.M.G.
Crown Surveyor.—Mr. J. W. MACGILLIVRAY, F.S.I.

Staff.—Authorized Establishment.—Crown Surveyor, 4 assistant surveyors, 1 draughtsman and tracer, 5 draughtsmen and 1 clerk.

Topographical Work.—The following work was completed :—

(1) A plan on a scale of 1/5,000 and longitudinal section over a distance of 30 miles between Port of Spain and the Quare and Aripo Valleys.

(2) Plans on a scale of 1/2,500 of the town of St. Joseph and three villages. Two other plans on this scale were in course of preparation.

(3) Plan on a scale of 1/5,000 over a distance of 39 miles between Curepe and Debe Railway Station.

Precise levels were run and permanent benchmarks established along the lines of main roads in (1) and (3) above, heights being referred to Trinidad Government Railway Datum.

A special staff consisting of two surveyors and a draughtsman were loaned by the Public Works Department for the above work.

Triangulation.—Eight new minor points were established for the control of the survey of Port of Spain.

Cadastral Field Work :—

Petition Surveys.—Crown lands surveyed for petitioners consisted of 189 village lots and 323 parcels, mostly of less than 10 acres.

Concession Surveys.—Forty-one survey orders for surveys of Crown Lands were completed, totalling about 14,331 acres. These surveys were executed by licensed surveyors of the Trinidad Petroleum Co., Ltd.

Survey of Reserves.—A total of 626 acres was surveyed by Contract Surveyors paid by the Forest Department.

Controlling Surveys.—35.8 miles of traverse surveys connected to the triangulation were carried out. All the traverse work was of secondary or tertiary class.

Office Work :—

Maps.—55 of the Warden's copies of the sectional maps were plotted up to date, and 3 cadastral sheets (1/50,000) were compiled.

Oil Maps and Reference Maps.—All additions and alterations were recorded on the maps specially kept for this purpose.

New Cadastral Sheets.—Eleven new sheets on a scale of 1/2,500 were completed and some work has been done on sixteen other sheets of this scale.

Plans.—1,234 grant plans, 102 lease plans, and 1,172 survey plans were made in connexion with petitions and other land transactions. The number of plans certified by the Crown Surveyor amounted to 840.

Expenditure.—The total expenditure amounted to £7,054 17*s.* 7*d.* Receipts from the sale of maps amounted to £231 13*s.* 6*d.*

Trinidad and Tobago, 1929.

Governor.—{ Sir Horace A. Byatt, K.C.M.G.
Sir Alfred Claud Hollis, K.C.M.G., C.B.E. (from October).

Crown Surveyor.—Mr. J. W. Macgillivray, F.S.I.

Staff.—4 Assistant Surveyors, 2 Draughtsmen, 4 Lady Draughtsmen, 2 Clerks.

Topographical.—Seventy acres north of Port of Spain were surveyed and plotted on a scale of 1/1,000 for a proposed residential development scheme.

A considerable number of bench marks, both primary and secondary, were fixed in the city of Port of Spain and six miles of precise levels were run.

Triangulation.—Twelve new minor Trigonometrical Stations were established for the survey of Port of Spain. Two intersected points were included and the average error of the eleven closed triangles was 3.8 seconds.

Cadastral Field Work.—The normal work was carried out on Petition Surveys, Concession Surveys, and Surveys of Reserves and Resumptions. 76.55 miles of controlling traverse surveys were run in connection with the survey of Port of Spain.

Expenditure.—The total expenditure of the Survey Department for the year 1929 was £8,431.

Uganda Protectorate, 1928.

Governor.—Sir W. F. GOWERS, K.C.M.G.
Director of Surveys, Land Officer and Commissioner of Mines.—Mr. D. BLAIR.

Non-Native Staff.—Authorized 31; a reduction of one on the numbers authorized in 1927.

Revenue and Expenditure.—Revenue £40,367 as against £44,535 in 1927.

The fall in revenue is accounted for by the addition in 1927 of over £5,000 due to the exercise of the last remaining options to purchase freehold a number of agricultural leases. This source of revenue has now disappeared.

Expenditure under votes £26,704, as against £25,960 in 1927.

Trigonometrical Survey.—Owing to the unsuitable terrain the chain of secondary triangulation to the Sudan via Lira referred to in the 1927 report was abandoned. A new line was found and a well-conditioned chain of 20 main stations was beaconed to within 10 miles of the Sudan Border.

A site for a base line with an almost ideal base figure was marked out. It was hoped to measure this in 1929. This base will complete the series required to give control to all the Uganda triangulations.

3,500 sq. miles were covered with main stations and of that area 600 sq. miles were beaconed with secondary stations.

Five stations were occupied and 420 sq. miles covered with main triangulation. Eleven secondary stations were beaconed and observations taken to them.

Traverses.—Additions to the main traverses in Busoga were made. These are essential to co-ordinate the floating surveys in Busoga.

131 miles of main and 20 miles of subsidiary traverses were completed. One main traverse of 16 miles remained to be done. A similar traverse of 16 miles was carried out in Budama. 63 miles of these traverses had been computed at the end of the year. The remaining computations and adjustments had still to be done.

Topography.—900 sq. miles on a scale of 1/50,000 were surveyed in the Eastern Province at a cost of Shs.26 per sq. mile including Minor Triangulation. Topography alone cost Shs.20.5 per sq. mile. Sketch contours were at 100 ft. V.I. in the plains and above 4,000 ft. on the Elgon slopes at 200 ft. V.I. Prints from the plane table sheets were issued to District Officers.

The whole of the Uganda portion of the Standard Topographical 1/250,000 sheet, North A-36-W (Mumias), was completed and ready for reproduction. Work on Sheet, North A-36-Q, had been started at the end of the year.

Cadastral.—Crown Lands: Subdivision work continued.

Land Settlement.—Buganda : 376,960 acres of new survey were carried out and 17,626 acres subdivided in old work. The cost was £7 per sq. mile (excluding Headquarters Administration) as against £9 12s. in 1927.

On a recomputed estimate 63 per cent. of the area in Buganda is complete on the Cadastral Survey.

1,495 miles of boundaries and tie lines were measured at Shs.55 per mile as against Shs.70 in 1927.

The Toro survey was completed with the exception of a few minor adjustments and the Ankole survey was started.

Native Plane Tablers.—Three native plane tablers have proved their usefulness and five are under training.

Computations.—East-West Longitudinal chain : The discrepancies of side values and azimuth were adjusted by simultaneous base and azimuth equations. The average correction per angle was ± 1.47 sec. for the 20 angles in the chain.

The adjusted values were to be used to recompute a new value for the original Uganda Survey Base Line and various chains and so form a grid to control survey work in the Protectorate south of parallel 1° 30′ N.

Drawing Office.—Owing to wear and tear 39 tracings and 16 original plane table sheets of the Mailo 1/10,000 plans were replaced by ferrogallic prints.

The principal map prepared during the year was the 1/500,000 of the Uganda Protectorate, in 4 sheets. It will also appear as 1/1,000,000 in one sheet with contour layers.

The standard 1/250,000 series Topo : sheet, North A-36-3 (Fort Portal), was printed and received and also the 1/500,000 compilation of the Western Province.

Experiments were carried out with various improved sun print papers with sufficient success to warrant an extended trial.

Land Office : Crown Lands.—It was confirmed that the maximum area of agricultural land which can be satisfactorily developed as a unit by one planter is 200–300 acres.

Native Settlement.—Final certificates for about 69.1 per cent. of the area granted to the natives were issued.

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Cocoa. World Production and Trade. May, 1930. (E.M.B. 27.) 1s. 0d. (1s. 3d.).

Empire Marketing Board. May, 1923 to May, 1930. June, 1930. (E.M.B. 28.) 1s. 0d. (1s. 3d.).

The Biological Control of Insect and Plant Pests. June, 1930. (E.M.B. 29.) 1s. 0d. (1s. 4d.).

Canadian Fruit Shipments. Report of an investigation into the Deterioration in Transit of Imported Canadian Fruit, 1927–29. June, 1930. (E.M.B. 30.) 1s. 0d. (1s. 2d.).

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A specimen of shea butter ("Lulu" oil) from the Sudan was also examined.

Seeds of Mimusops Djave.—A consignment of these seeds was received from Southern Nigeria. They were found to contain a fat which resembles shea butter and would have similar commercial applications.

Seeds of Ricinodendron sp.—A sample of "Nsa-sana" seeds, probably derived from a species of *Ricinodendron*, were received from Southern Nigeria, and were found to contain a qui .rying oil which could be utilised as a substitute for T'ung oil.

Seeds of Carapa guineensis.—The seeds of *Carapa guineensis* from the Gold Coast were examined and found to yield an oil which would be useful for soap-making, and would probably realise from £22 to £30 per ton.

Castor Oil Seeds.—Six samples of castor oil seed were received from the Sudan, three from the Red Sea Province, two from the Bahr-el-Ghazal and one from the Kassala Province. One of the samples from the Red Sea Province was worth about 5*s.* per ton in advance of Bombay castor seed, one was dirty and almost unsaleable, and all the other samples were of about the average quality of Bombay castor seed.

Eight samples of castor oil seed from Southern Rhodesia were of good quality and worth, on the average, £12 per ton.

A memorandum on the cultivation of the castor oil plant, the collection of the seed, and the preparation and utilisation of the oil was forwarded to Cape Colony in reply to a request for information on the subject.

Oil from the Seeds of Lophira alata.—Samples of this oil were received from Sierra Leone and also from the Sudan. Both specimens contained a quantity of unsaponifiable matter which would interfere with the use of the product for soap-making. It was considered probable, however, that this undesirable substance might not be removed from the seeds by the methods used for expressing the oil on a manufacturing scale, in which case the oil would be worth about £20 per ton.

Several other products were examined including the oils of *Calophyllum tomentosum* and *Amoora Rohituka* from India, "Margose" seed and seeds of *Melia Azadirachta* from India, fruits of *Pycnanthus* sp. from Northern Nigeria, a sample of beeswax from Rhodesia and a sample of sesame seed from Southern Rhodesia.

Among the various products remaining under investigation at the end of the year may be mentioned two samples of a variety of shea nuts from Sierra Leone, a specimen of castor oil seed from Rhodesia, dika nuts from Southern Nigeria, mafoureira nuts from Mozambique, and raphia wax from Madagascar.

VOLATILE OILS.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Cyprus	2	Cyprus	1	Cyprus	3
Federated Malay States.	2	Seychelles ...	6	Uganda	1
		Fiji	2	India	3
Seychelles... ...	10	Sierra Leone ...	1		
Total... ...	14	Total... ...	10	Total... ...	7

Cyprus.—A sample of the origanum oil produced in Cyprus in 1905 was found to be of good quality and similar to the 1904 crop. A consignment of the oil was subsequently sold at 3*s.* per pound. A sample of Marjoram herb was also received for examination.

Seychelles.—Ten specimens of volatile oils were received from the Seychelles, including Bigarade, Seychelles lemongrass, Ceylon lemongrass, Ylang ylang, Mozambique orange, Ceylon citronella and cananga oils. The samples were too small for more than a preliminary examination. The results, however, were very promising and were considered to justify the preparation of larger quantities of the oils with a view to testing the market.

Federated Malay States.—Samples of patchouli and citronella oils from the Federated Malay States were examined. Both were of good quality and saleable at 9*d.* per oz. and 1*s.* 10*d.* per lb. respectively.

1907.

Cyprus.—A sample of geranium oil was received from Cyprus, but was insufficient for complete examination. A memorandum was forwarded on the cultivation and collection of peppermint and geranium plants and the methods of distilling the oils from them.

Seychelles.—Two samples of citronella oil and two samples of lemongrass oil were examined. The citronella oils were of good quality and regarded as worth 1*s.* 10*d.* to 2*s.* per pound. The lemongrass oils were of rather low grade.

A specimen of clove leaf oil was received for examination. This product possessed an odour somewhat different from that of ordinary clove oil, but contained 87 per cent. of eugenol, and was valued at 4*s.* to 4*s.* 6*d.* per pound. It was pointed out that the production of this essential oil would appear to afford good prospects in the Seychelles.

A sample of cinnamon bark oil was found to differ considerably from that prepared from Ceylon cinnamon bark, and to

contain less than one-third of the usual amount of cinnamic aldehyde (the chief constituent). It was suggested that this peculiarity may have been due to faulty preparation.

Fiji.—Two small samples of the volatile oil of *Cinnamomum pedatinervium* bark were examined and found to be similar to that examined previously. This product would be useful for perfuming soaps, and would probably realise about 1*s.* 6*d.* per pound.

Sierra Leone.—A consignment of the leaves of *Ocimum viride* was received for examination. This product yields a volatile oil which would doubtless be of value on account of the large proportion (32 per cent.) of thymol which it contains, and it is probable that the residue left after removing the thymol could be used for scenting soaps.

A request was received from a firm of merchants working in Southern Nigeria for information with reference to lemongrass oil. In reply, a memorandum was forwarded giving a general description of the cultivation of lemongrass and the process of obtaining the oil.

At the close of 1907, the following materials remained under investigation: the turpentine oil of *Pinus longifolia* from India, Origanum oil from Cyprus, and the roots of *Chlorocodon* sp. from Uganda.

Foodstuffs.

Samples reported on during 1906	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Gold Coast ...	7	Gambia	2	Southern Nigeria	3
Transvaal... ...	1	Gold Coast ...	2	Natal	17
Somaliland ...	1	Southern Nigeria	14	Rhodesia... ...	1
Sudan	12	Natal	1	Trinidad... ...	2
Seychelles... ...	2	Uganda	1		
India	14	Sudan	4		
Ceylon	2	Ceylon	1		
Hong Kong ...	1	British Honduras	1		
United Kingdom...	1	United Kingdom	38		
Total... ...	41	Total... ...	64	Totol... ...	23

The samples included under this heading belong to comparatively few groups, which may conveniently be discussed separately.

Tea.

In view of the statement frequently made that Chinese tea is less harmful in use than Indian tea, a careful comparison was made at the request of the India Office, of typical samples

of these two classes of teas. The results show that the Indian teas are richer in the stimulant alkaloid caffeine than Chinese teas, and yield more extractive matter to water; but they also contain more tannin.

This enquiry was also extended to Natal teas, typical samples of which were forwarded by the Natal Government at the close of the South African Products Exhibition held recently in London. The Natal teas proved similar to Indian teas on the whole, but the samples from one estate were found to contain rather less tannin than average Indian tea.

The sample from Hong Kong was tea from plantations in the New Territory. It was of poor quality and not suitable for import into this country.

Samples of a substitute for tea prepared in Ceylon were also examined. These consisted of the dried leaves of *Cassia auriculata* and contained only a trace of caffeine, so that they are unsuitable for use in place of tea.

Coffee.

A number of samples of coffee from Abyssinia as imported into the Anglo-Egyptian Sudan were received from the Government of the Sudan for examination, and samples of coffee were also received from the Transvaal and India. The last mentioned samples were from an estate in Mysore and represented the products obtained before and after manuring the land on which the plants were grown. The effects of the manuring were a slight increase in the amount of caffeine in the berries, and an increase both in the size of the berries and in their density.

Cocoa.

An unusual amount of interest has been aroused in this product, during recent years, owing to the very high prices which have prevailed, and consequently a considerable number of samples of cocoa both from Colonies which have not hitherto produced this material in quantity, and from Colonies in which the industry has long been established, have been received for examination and report.

Cocoa cultivation is being established on a large scale in the Gold Coast, and this article is now one of the most important exports. The product exported is, however, of inferior quality, the beans being small and usually incompletely fermented. Further the industry is said to be hampered to some extent by certain trading difficulties. Both these sides of the problem, viz., the agricultural and economic, have received attention during the two years under review, and several reports and recommendations have been made.

In 1906 a series of samples of cocoa prepared in the Botanic Gardens at Aburi were received for examination. These had

been fermented in various ways and for different periods of time. They were subjected to complete chemical examination, and from the results obtained it was possible to draw up a series of recommendations for the improvement of the cultivation and preparation of Gold Coast cocoa.

During 1907 the Government of the Colony desired to obtain exact information as to the prices which the better classes of Gold Coast cocoa would secure when sold in the United Kingdom, so that if necessary steps might be taken to improve the local trade conditions under which the same price is paid for cocoa of all grades of quality. In consultation with the Imperial Institute, two consignments of selected cocoa were sold in Liverpool. These realised unusually good prices, ranging from 65 to 69 shillings per cwt. So far, Gold Coast cocoa has been utilized on the Continent and has not attracted much attention from manufacturers in this country, but as the result of the action recorded above, several British firms have begun to take an interest in this product, and it seems likely that in the near future a larger proportion of this cocoa will be used in this country.

Interesting samples of cocoa produced experimentally in British Honduras and Uganda were received during 1907. Both of these proved to be of good quality, and the commercial experts who examined the samples regarded them as both readily saleable in this country. In Uganda especially there seems to be an important future for cocoa cultivation.

Food Grains.

The samples examined included wheat, barley, rice, millet, guinea corn, and maize, and were received for the most part from the Sudan and the West African Colonies. A memorandum on the cultivation, preparation, and marketing of maize was prepared for the Government of Southern Nigeria, and similar information regarding wheat was supplied to the Government of the Sudan.

A material of special interest was the "yebb" or "yeheb" nuts received from Somaliland. As the seeds were apparently unknown they were submitted to Kew for botanical identification. On examination these seeds proved to be rich in carbohydrates, oil, and proteids, so that they form in themselves a complete food. It is stated that yeheb nuts have formed almost the sole food of the Somalis during recent famine years. If further investigations should prove that the seeds are readily digestible, the plant (*Cordeauxia edulis*, Hemsley) may prove to be of value in other countries.

Miscellaneous Food Products.

These included "cocoa nut water" from Ceylon, which was examined with a view to ascertaining if it could be used as

a source of sugar; native sugar cane from Rhodesia, which is still under investigation ; alcohol prepared in Ceylon from the cashew nut, and rum obtained from sugar residues in Natal.

A large number of samples of English cured hams have been examined during 1907 for the Board of Trade and the Foreign Office, in connection with the new regulations with reference to the importation of hams into certain foreign countries.

SPICES, &c.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Sierra Leone ...	4	Sierra Leone ...	3	Seychelles ...	3
Gold Coast ...	1	Sudan	6		
Southern Nigeria...	1	Federated Malay States.	1		
Sudan	7	Mauritius ...	1		
Total... ...	13	Total... ...	11	Total... ...	3

1906.

Sierra Leone.—The spices received from this Colony were samples of ginger, guinea grains and fruits of *Xylopia ethiopica*. The first of these represented ordinary Sierra Leone ginger prepared by native methods, and a second sample the spice prepared by improved methods, involving washing and partial decortication. The sample prepared in the latter way proved to be much superior to the ordinary quality, and was valued at a higher price.

Gold Coast.—A sample of cinnamon bark was received, prepared from trees grown in the Botanical Gardens at Aburi. It was not well prepared, but was of good aroma and flavour, and was valued at 5*d.* to 6*d.* per pound, as compared with 8*d.* to 9*d.* per pound then being paid for well-prepared cinnamon.

Sudan.—The samples received included ginger, cardamoms, cumin seed and foenugrec, products which reach that country from Abyssinia. Most of these materials were of fair and saleable quality.

1907.

Sierra Leone.—The question of improved cultivation and preparation of ginger in the Colony received further attention during this year. A memorandum was prepared for the Government of the Colony giving information on these subjects and subsequently small consignments of ginger were shipped to this country representing: (1) ginger prepared by

the improved method, (2) ginger prepared by the native method, but thoroughly dried. These were sold in London by arrangement with the Imperial Institute. The better prepared ginger realised from 64*s.* to 66*s.* per cwt. as against 32*s.* 6*d.* paid for the product prepared in the usual way, clearly indicating that it would be advantageous for planters to devote more attention to the preparation of the ginger for the market.

Sudan.—These samples included garlic, ginger, coriander, cumin, and cardamoms as imported into the Sudan from Abyssinia. They were mostly of readily saleable quality.

A sample of cinnamon bark was received from the Federated Malay States, and a specimen of the fruits of *Pimenta acris* from Mauritius. The first of these was thick and not well prepared, and therefore of merely nominal value. Further supplies of the fruits of *Pimenta acris* have been asked for for examination. At the end of the year samples of vanilla from the Seychelles were under investigation.

TANNING MATERIALS.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Transvaal	1	Gambia	1	Gold Coast ...	1
Uganda	2	Sierra Leone ...	1	Foreign Countries	3
Somaliland ...	3	Gold Coast ...	1		
Sudan	1	Transvaal ...	1		
Seychelles... ...	1	Cape Colony ...	10		
India	14	Uganda	3		
Western Australia	3	Sudan	2		
British Guiana ...	1	Seyschelles ...	12		
		British Honduras	4		
		Brazil	1		
Total... ...	26	Total... ...	36	Total... ...	4

1906.—None of the samples of tanning materials examined proved to be sufficiently rich in tannin to be worth consideration for export to the United Kingdom, but most of them were of fair quality and suitable for local use in tanning. This is the case, for example, with the three interesting materials from Somaliland, viz., "Wattu" leaves derived from *Osyris abyssinica*, a near relative of the plant which yields the so-called "Cape Sumach," "gallol root bark," from a species of Acacia near *Acacia latronum*, and "maua bark," of unknown botanical origin. These yielded respectively 24·8, 24·0, and 13·7 per cent. of tannin. The two first-mentioned furnished leathers of medium quality whilst that prepared with maua bark was of fair quality, but rather harsh and somewhat dark coloured.

The samples from India were extracts prepared from the barks of *Shorea robusta*, *Terminalia tomentosa* and *Rhizophora mucronata*. Of these the most promising were those prepared from the last-named bark. They contained high percentages of tannin, but were rather dark coloured, indicating the need for greater care in evaporating the liquors prepared as a first step in the manufacture of the extracts.

1907.—The samples from Cape Colony included six samples of wattle bark derived from the golden wattle, *Acacia pycnantha*, and the black wattle, *Acacia decurrens*. All these proved to be of good quality and similar in type to the wattle barks now imported from Natal and Australia. They were valued at from £7 10*s*. 0*d*. to £7 15*s*. 0*d*. per ton.

The other samples from Cape Colony were samples of barks from indigenous trees, "White thorn" (*Acacia horrida*), "Krupeehout," "Kliphout," and of Cape Sumach. These were all of poorer quality than the wattle barks, and most of them though suitable for local use were of no value for export.

The samples from Uganda included "Busana bark," derived from a species of Acacia, probably *Acacia spirocarpa*. This is being used in the neighbourhood of Entebbe as a tanning material. It contains about 10 per cent. of tannin and yields a rather harsh, dark-coloured leather, and should only be used in admixture with the better materials imported to Uganda from India. A sample of the bark of *Terminalia velutina* was also received from Uganda. This contained 12 per cent. of tannin and yielded a light-coloured leather of fair quality.

The Sudan materials were samples of Kili bark from *Ficus sp.*, and "Alimu" bark from *Ximenia americana*. The latter proved to be of fair quality for local use.

The samples from the Gambia, Sierra Leone, Gold Coast Colony, Seychelles and British Honduras were all mangrove barks. Of these samples certain of those from the Seychelles alone yield sufficient tannin (*i.e.*, over 40 per cent.) to be worth consideration for export. The other samples could only be used locally for tanning or for the manufacture of tanning extracts. The samples from British Honduras and the Gambia, however, included barks which were of special interest on account of the unusually good and light-coloured leather they produced, for mangrove barks. The examination of this large collection of mangrove barks has enabled some useful information to be obtained regarding the value of scraping off the outer bark before shipment, and it seems certain that in most cases the outer bark contains little or no tannin, and its removal before export raises the average tannin content of the bark and reduces the bulk.

The sample from Brazil was "barbatimao bark," sent by the British Consul at Rio de Janeiro with a view to ascertain-

ing whether this material, largely used in Brazil for tanning, is of commercial value. The sample proved to contain 27·8 per cent. of tannin and to yield a leather of very good quality. It is worth noting that this tree has been introduced recently into German East Africa with a view to the utilisation of its bark for tanning purposes.

At the end of the year a sample of divi-divi pods from the Gold Coast and samples of mangrove bark from Portuguese East Africa were still under investigation.

Dyestuffs.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Lagos	1	Sierra Leone ...	1	Nil.	
Rhodesia	2	Rhodesia ...	1		
		Sudan	2		
		Seychelles ...	4		
		India	4		
		Miscellaneous ...	3		
Total ...	3	Total ...	15	Total ...	Nil.

Natural dyestuffs are now of little or no economic importance, and with the exception of indigo and a few of the yellow dyewoods and logwood, they have been almost entirely supplanted in European dyehouses by synthetic dyes of chemical origin.

1906.—The samples received in 1906 consisted of annatto seeds from Lagos and native-made indigos from Rhodesia. Annatto is still used to a considerable extent in colouring butter and margarine. The Lagos sample was of good quality. The Rhodesian indigos contained only 3·7 to 18·5 per cent. of real indigo, and were of no value for export purposes.

1907.—The "Gara" plant is used as a blue dyestuff in West Africa. It contains indigotin identical with that present in the various species of *Indigofera* used as sources of indigo in India, Java and elsewhere.

The Sudan samples were of the red dye "Sikhtiyan," derived from a species of "dura," the stems of which secrete the red colouring matter. The latter was shown to be a substantive red dye of the type present in red sandal wood.

The Seychelles samples were "orchella weeds," for which there is still some slight demand as a dye. Three of these samples were of good quality and equal to the weed now exported from Ceylon and Portuguese East Africa.

Of the three Indian dyestuffs *Onosmea echioides* contained a red dye like that present in alkanet root; *Hibiscus Sabdariffa*,

two yellow colouring matters, one of which is of the quercetin type of yellow dye; and *Thespesia Lampas*, the yellow colouring matter quercetin. In *Baccaurea sapida* no evidence of the possession of tinctorial properties could be obtained.

During 1907 a memorandum describing the cultivation of annatto and the preparation of the seed and dye for the market was prepared for the Government of Ceylon.

The miscellaneous dyestuffs received were mainly from commercial firms in this country, and included camwood and several lichens of the orchella and other types.

Resins.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Sierra Leone ...	2	Cyprus	1	Gold Coast ...	1
Gold Coast ...	3			Southern Nigeria	1
India	1			India	3
Federated Malay States.	1				
Foreign countries...	1				
Total... ...	8	Total... ...	1	Total... ...	5

West African Colonies.—These samples were chiefly copals sent for valuation and for information as to the desirability or otherwise of "scraping" and "grading" them for shipment.

India.—These included samples of the resin of *Canarium bengalense*, which was found to be suitable for use as a varnish, and specimens of the common resin or colophony prepared from the "long-leaf pine" of India. The latter is still under examination, and a careful comparison of it with French and American colophony is being made.

The other samples received included specimens of elemi from Liberia and Southern Nigeria, and a sample of ladanum from Cyprus—a material at one time used in medicine and perfumery.

Gums.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Northern Nigeria	1	Orange River Colony.	1	Northern Nigeria	1
Sudan	1	Uganda	1	Foreign Countries	16
		Somaliland ...	4		
		Foreign Countries	1		
Total... ...	2	Total... ...	7	Total... ...	17

1906.—The sample of gum from Northern Nigeria was sent by the Forestry Officer from Bornu Province. It was of the usual Nigerian type and of good quality. The Sudan sample was Talh gum of the usual quality.

1907.—The sample of gum from the Orange River Colony was from the "white thorn" (*Acacia horrida*), and was of a type not readily saleable in this country. That from Uganda was from *Albizzia Brownei*, and was of insoluble type. The samples of Somaliland gums were too small for examination or valuation.

At the end of 1907 a sample of gum from *Acacia Caffra*, collected in Northern Nigeria, was still under investigation, in connection with the question of the development of the gum industry in that country.

Drugs.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Gold Coast ...	4	Gold Coast ...	3	Sierra Leone ...	4
Sierra Leone ...	13	Northern Nigeria	4	Northern Nigeria	1
Uganda	1	Sudan	2	Lagos	1
Rhodesia	1	Nyasaland ...	1	British East Africa	1
Zanzibar	1	Natal	1	Somaliland ...	1
Transvaal	1	India	1	India	30
Sudan	3	Straits Settlements.	19	Straits Settlements.	1
India	3	Federated Malay States.	1	New South Wales	1
		New South Wales	1	Foreign Countries	2
		British Honduras	2		
		Foreign Countries	2		
Total... ...	27	Total... ...	37	Total... ...	42

A considerable number of drugs have been dealt with during the two years 1906 and 1907. In this connection it may be noted that Indian Podophyllum (*P. Emodi*) and Egyptian henbane (*Hyoscyamus muticus*), the constituents of which have been previously examined at the Imperial Institute and shown to be of medicinal value, are now being regularly exported for use as drugs.

The most important of these investigations conducted in the two years referred to are those carried on for the Government of India, and include the chemical examination of Indian species of Aconites, Hyoscyamus, Datura and Strychnos, and also Indian opium and opium alkaloids. Considerable progress has been made with the first four of these enquiries, which are, however, not yet completed.

The investigation of the best process of extracting the alkaloids from Indian opium is now practically complete. A new process has been devised for the preparation of morphine and codeine from waste Indian opium at the Indian Government Factory at Ghazipur. Preliminary trials of this process on a small commercial scale have been carried out, and these were so successful that plant for carrying out this process has been devised, and is now being constructed under the supervision of the Department for despatch to India.

The other samples referred to above have been mainly drugs in use by natives in the countries mentioned, and in a few cases the preliminary examination of these has shown that they are likely to be worth full investigation, and arrangements have been made for undertaking this. Passing mention may be made of drugs from the Sudan, which were specimens of the well-known drugs, senna leaves and pods. These were of fair quality.

The samples from the Straits Settlements in 1907 consisted of morphine salts, forwarded for a report on their purity and commercial value. A sample of coca leaves was received from the Federated Malay States, where the cultivation of this plant is now receiving attention. These proved to be of fair quality, and suggestions were made as to improvements in the preparation of this material for the market.

Other samples received in 1907 and worth mention were kola nuts from the Gold Coast Colony which were of saleable quality, hops from India, valued at 30*s*. per cwt. as compared with English hops then selling at 40*s*. per cwt., and a number of arrow poisons from Northern Nigeria, which proved almost invariably to be species of Strophanthus.

Two so-called "soap plants" were examined, "Gusangus" root from Somaliland and "soap berries" and leaves from British Honduras; both of these contained saponin-like substances.

The products awaiting investigation at the end of 1907 were mainly native drugs of the types already alluded to. Those from India were *Hyoscyamus*, *Datura* and *Aconitum* species, the investigation of which is being continued.

POISONOUS PLANTS.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Lagos and Southern Nigeria.	2	India	6	Transvaal ...	1
				Cape Colony ...	1
				Federated Malay States.	1
				New South Wales	1
Total ...	2	Total ...	6	Total ...	4

In continuation of the work done at the Imperial Institute since 1900 in the investigation of plants which have proved poisonous to cattle, a number of materials of this type have been investigated during 1906 and 1907.

From Lagos samples of the "afon" fruit reputed to be poisonous to horses were received, but on chemical and physiological examination of this material no toxic substance could be detected.

Chailletia cymosa from the Transvaal, *Senecio latifolius* from Cape Colony, and *Swainsona galegifolia* from New South Wales are under investigation, and some progress has been made with all of those, but as such work involves the isolation and complete investigation of the toxic constituent present in each plant, progress is of necessity slow.

The vegetable products from India referred to in the table were all white or red Rangoon beans submitted usually by commercial firms for identification and information as to their suitability for feeding cattle. The question of the safety of using these beans for feeding purposes in Great Britain is still under investigation in consultation with the Board of Agriculture.

TOBACCO.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Southern Nigeria...	1	Northern Nigeria	3	St. Vincent ...	1
Northern Nigeria...	1	British East Africa.	1	Foreign countries	54
Rhodesia	1	Trinidad... ...	1		
Ceylon	1	Bahamas... ...	2		
British Honduras	1				
Bermuda	1				
Total ...	6	Total ...	7	Total ...	55

1906.

Northern Nigeria.—This was a sample of tobacco grown on the banks of the Kaduma River and prepared by native methods. It was of fair quality, and though not fully fermented, burned well, and was valued at about 4*d.* per lb.

Rhodesia.—The sample from Rhodesia was a Turkish tobacco of promising quality, and was valued at 10*d.* per lb.

British Honduras.—This sample of tobacco was prepared by Indians in the Colony by the usual methods. It was of rather full flavour and pungent, but possessed good burning properties and fair aroma, and was valued at 4*d.* per lb.

The other samples received were not of a quality saleable in the United Kingdom; that from Bermuda was part of a crop raised experimentally in the Island, and was of good appearance, but did not burn well. The Ceylon tobacco was of the usual type produced in the Island, which has a large export trade in coarse tobacco to India and elsewhere. This tobacco is, however, quite unsuitable for import into the United Kingdom.

1907.

British East Africa.—Considerable interest is being shown in this Protectorate and in Uganda in the possibility of producing tobacco suitable for export to the United Kingdom, and at the suggestion of the Director of the Imperial Institute, an expert has been appointed by the Colonial Office to conduct experiments in the cultivation and preparation of tobacco, and to give advice to planters and others on these matters. The sample received in 1907 was from a firm of planters in the Protectorate. It was of the cigar class, and proved to be of a good type, but was improperly fermented and did not burn well.

The samples from Trinidad and the Bahamas were portions of experimental crops, and, though suitable for local use for cigar manufacture, were not of a type which is saleable in this country.

At the end of 1907, 54 typical samples of Greek and Turkish tobaccos obtained by the Director of the Imperial Institute during his visit to the Levant for the Colonial Office, were under investigation in connection with the growth of similar tobaccos elsewhere.

MISCELLANEOUS.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Southern Nigeria...	2	Southern Nigeria	2	Nil.	
Natal	1	Northern Nigeria	1		
Sudan	2	Sudan	1		
Ceylon	1	Various	2		
Various	6				
Total... ...	12	Total... ...	6	Total... ...	Nil.

In this group is included a number of products, which do not readily fall into any of the groups already dealt with. A few of these materials are of some general interest. The

specimens from Southern Nigeria included "ninkon fruits" used in West Africa as a sweetening agent. These were found to contain a small quantity of an intensely sweet substance, but the difficulty of extracting it makes the fruits of no economic value.

The sample from Ceylon was papain, the ferment present in the fruit of the papaw, which is used to some extent in medicine as a digestive agent. This was of fair quality and was valued at 5*s*. per pound.

From Natal, Itala nuts, the product of *Hyphæne crinita*, were received. These may be of some value as a source of vegetable ivory.

During the two years under review, collections of botanical specimens have been received from Northern Nigeria, Somaliland, and from various West African Colonies. These have been transmitted to the Royal Gardens, Kew, for identification. In addition, a considerable number of separate botanical specimens received in connection with vegetable products under examination at the Imperial Institute have been received, and these also have been identified at Kew.

Animal Products.

Samples reported on during 1906.	No	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Sudan	6	Natal	1	Transvaal ...	1
New South Wales	1	Uganda	5	Sudan	1
		Sudan	2	India	1
		India	1		
		Ceylon	1		
		Western Australia	1		
Total... ...	7	Total... ...	11	Total... ...	3

Uganda.—Skins and leather tanned with local or imported tanning materials were sent for valuation and for suggestions as to methods of improvement. The products were all of saleable, though rather poor, quality, and various recommendations were made as to the preparation and tanning of skins intended for export to the United Kingdom.

Sudan.—The samples included civet imported from Abyssinia, hippopotamus teeth, and sponges, all of which were sent for valuation. The first two were of good quality and of types readily saleable in this country. The sponges, on the contrary, were of doubtful quality, and there may be some

difficulty in finding a market for such products in this country.

Transvaal.—The sample from this Colony consisted of dried locusts. These have been analysed, and it is considered that they may be found suitable for use as a poultry food.

Sponges were received from Ceylon and Natal, New South Wales and Western Australia. Several of these were of promising though rather poor quality, but most of them were of no value in this country.

Insect and Fungoid Pests.

Specimens reported on during 1906.	No.	Specimens reported on during 1907.	No.	Specimens awaiting investigation at the end of 1907.	No.
Seychelles... ...	4	West Africa ...	1	Nil.	
		British East Africa.	1		
Total... ...	4	Total... ...	2	Total... ...	Nil.

The insect pests received included several which attack coco-nut palms and some of those affecting banana plants in the Seychelles. From West Africa was received a "blight" which attacks guinea corn. These pests vere identified by the experts of the Natural History Section of the British Museum.

The East African material was a root of a coffee plant affected by a fungus, which was identified at the Royal Gardens, Kew.

Where possible recommendation for the destruction and prevention of these pests were supplied by the Authorities referred to, and were transmitted to the Governments concerned.

A number of questions connected with the occurrence and treatment of insect pests in West Africa have been dealt with by Mr. G. C. Dudgeon.

VIII.—SUBSIDIARY WORK.

As has been previously stated in connection with the supply of information respecting emigration and settlement in the Colonies, the Imperial Institute has worked in co-operation with the Emigrants' Information Office, as well as with the agencies established in London under the auspices of the Colonial Governments. The publications issued by the Emigrants' Information Office have been supplied to enquirers as well as those published by the Governments concerned. The British Women's Emigration Association, which carries on special work connected with the emigration of women, has been provided with an office in the Imperial Institute, which, under the charge of Miss Lefroy, has been largely consulted by enquirers.

The Colonial Nursing Association, which has branches in most of the Crown Colonies and Protectorates, has been provided with a central office in the Imperial Institute, under the care of Miss Dalrymple Hay. From this office the work of selecting trained nurses for the Colonies has been carried on.

The African Society for the study of questions relating to the African Colonies and Protectorates has been granted the use of an office in the Imperial Institute, and the meetings of the Council have been held in the African Conference Room, where meetings of Committees of the Egyptian Government have also been held.

The Conference Rooms have been utilised for several meetings, and larger meetings have been held in the Jehanghier Hall or in the Great Hall. The British Women's Emigration Association, the Colonial Nursing Association, the Royal British Nurses' Association, the Victoria League, and the National Indian Association are among the societies which have held such meetings. A reception was held in the galleries in July, 1906, by Lord Strathcona, High Commissioner for Canada. The Annual Meeting in July, 1907, of the Victoria League, which was held in the Great Hall, under the presidency of the Countess of Jersey, was very largely attended, and was followed by a reception held in the Exhibition Galleries. The Colonial Premiers, at that time in England, took part in the proceedings.

COLONIAL REPORTS.

The following recent reports relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
547	Mauritius	1906
548	Fiji	"
549	Jamaica	1906–1907
550	British Guiana	"
551	Northern Nigeria	"
552	British Honduras	1906
553	St. Lucia	1906–1907
554	Southern Nigeria	1906
555	St. Vincent	1906–1907
556	Basutoland	"
557	East Africa Protectorate	"
558	Uganda Protectorate	"
559	Swaziland	"
560	St. Helena	1907
561	Ceylon	"
562	Falkland Islands	"
563	Gibraltar	"
564	Ashanti	"
565	Colonial Survey Committee	1907–1908
566	Northern Territories of the Gold Coast	1907
567	Seychelles	"
568	Bermuda	"
569	Weihaiwei	"
570	Hong Kong	"
571	Malta	1907–1908
572	British Honduras	1907
573	Gold Coast	"
574	Nyasaland Protectorate	1907–1908
575	Bahamas	"
576	Gambia	1907
577	St. Vincent	1907–1908
578	Turks and Caicos Islands	1907
579	St. Lucia	"
580	Fiji	"
581	Mauritius	"
582	Straits Settlements	"
583	Southern Nigeria	"

MISCELLANEOUS.

No.	Colony, &c.	Subject.
49	East Africa Protectorate	Veterinary Department.
50	British Colonies, &c.	Cotton Cultivation.
51	Southern Nigeria	Forest Administration.
52	South Africa	Native Education.
53	East Africa Protectorate	Veterinary Bacteriological Work, 1907–8.
54	Newfoundland	Governor's Visit to the Micmac Indians.
55	Cape Colony	Rietfontein Area.
56	Turks and Caicos Islands	Salt Industry.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE.
BY DARLING & SON, LTD., 34-40, BACON STREET, E.

1908.

COLONIAL REPORTS—ANNUAL.

No. 601.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, 1908.

(For Report for 1906 and 1907, *see* [Cd. 3729–48.] 1908.)

Presented to Parliament by Command of His Majesty.

July, 1909.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY DARLING & SON, LTD., 34-40, BACON STREET, E.

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[Cd. 4448-10.] *Price* 2½*d.*

No. 601.

IMPERIAL INSTITUTE, 1908.

(For Report for 1906 and 1907, *see* [Cd. 3729—48.] of 1908.)

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE IN 1908. By Professor Wyndham R. Dunstan, M.A., LL.D., F.R.S., *Director.*

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I.—PREFATORY STATEMENT.

THE IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA.

Trustees.

The First Commissioner of His Majesty's Treasury.
The Secretary of State for the Colonies.
The Secretary of State for India.
The President of the Board of Trade.

Advisory Committee.

(Appointed under the provisions of the Imperial Institute Transfer Act, 1902.)

The Right Hon. Lord James of Hereford, G.C.V.O. (Chairman).
Sir F. Hopwood, G.C.M.G., K.C.B.
Sir Alfred Bateman, K.C.M.G.
The Right Hon. Lord Allerton.
Sir H. Llewellyn Smith, K.C.B.
The Right Hon. Sir C. Clementi Smith, G.C.M.G.
Sir E. C. Buck, K.C.S.I.
Sir T. W. Holderness, K.C.S.I.
Sir Thomas Elliott, K.C.B.
Colonel Duncan G. Pitcher.
The Right Hon. Lord Strathcona and Mount Royal, G.C.M.G.
Captain R. Muirhead Collins, R.N., C.M.G.
The Hon. W. Pember Reeves.
The Hon. Sir W. Arbuckle, K.C.M.G.
Sir C. P. Lucas, K.C.M.G., C.B.
(One vacancy to be filled.)

Managing Committee.

The Right Hon. Sir C. Clementi Smith, G.C.M.G. (nominated by the Colonial Office).
Sir Alfred Bateman, K.C.M.G. (nominated by the Board of Trade).
Colonel Duncan G. Pitcher (nominated by the India Office).

Director.

Professor Wyndham R. Dunstan, M.A., LL.D., F.R.S.

The Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May, 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of the Colonies and India, and providing for their investigation and for the collection and dissemination of scientific, technical, and commercial information relating to them.

The work of the Imperial Institute is at present carried on under four principal divisions: (1) the Colonial and Indian collections, consisting mainly of raw materials and primary manufactures displayed in the public exhibition galleries, and including a Central Stand for receiving enquiries and distributing publications; (2) the Scientific and Technical Department, including a

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special staff and research laboratories occupying the second floor of the building; (3) the Reference Library, containing a large collection of works of reference relating to the Colonies and India, together with the principal periodicals and newspapers; (4) the "Bulletin of the Imperial Institute," a quarterly publication containing a record of the work of the Imperial Institute in its various branches, as well as special articles on subjects connected with the industrial utilisation of mineral and vegetable products.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which His Royal Highness the Prince of Wales (now His Majesty the King) was President, and an Executive Council, including representatives of the Indian Empire and of all the British Colonies and Dependencies. In 1900 the building became the property of His Majesty's Government, by whom the western portion and galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portions being assigned for occupation by the University of London. In July, 1902, an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee, including representatives of the Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A Committee of Management of three members, one nominated by each of the three Government Departments chiefly concerned, has been appointed.

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and to the commercial utilisation of economic products.

The following are the principal departments of the Institute:—

Colonial and Indian Collections.—The collections of economic products, &c., illustrative of the general and commercial resources of the Colonies and India are arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday, and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter.

The following British Colonies and Dependencies are represented by Collections:—Canada, Newfoundland, Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahama Islands, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda, Falkland Islands, New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, New Zealand, Fiji, Cape of Good Hope, Natal, Transvaal, Orange River Colony, Rhodesia, Nyasaland, St. Helena, Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, British East Africa, Zanzibar and Pemba, Uganda, Somaliland, the Anglo-Egyptian Sudan, Malta, Cyprus, Ceylon, Hong Kong, Mauritius, Seychelles, Straits Settlements, the Federated Malay States, and India.

Special arrangements are made for the conduct of schools and institutions desirous of visiting the Colonial and Indian collections for educational purposes.

A stand has been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Pamphlets, circulars, handbooks, &c., containing information relating to the commerce, agriculture, mining, and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. The principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the departments in the main building.

The Scientific and Technical Department.—The research laboratories of this department, which occupy the second floor of the Imperial Institute, were established in order to provide for the investigation of new or little-known natural products from the Colonies and India, and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade, and industries of the Colonies and India.

The work of this department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have been also made by the Foreign Office, whereby British representatives abroad may transmit to the department for investigation such natural products of the countries in which they are appointed to reside as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the department, and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

Except under special circumstances investigations are not undertaken for private individuals.

A Reference Sample Room is maintained in this department, in which are arranged samples of the principal materials which

have been investigated and valued commercially during recent years, and as to which full information is available.

The Scientific and Technical Department works in co-operation with the Agricultural and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations and enquiries as are of a special character, scientific or technical, connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial value of products (vegetable and mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which has been printed in a volume of "Technical Reports and Scientific Papers," published in 1903, whilst a selection of the later reports has been printed in the "Bulletin of the Imperial Institute."

Mineral surveys, under the supervision of the Director of the Imperial Institute, and conducted by surveyors selected by him, are in progress in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland, and preliminary arrangements of a similar nature have been made in connection with British East Africa and with the Anglo-Congolese Boundary Commission in Uganda. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained. Reports by the Director on the results of the mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

In connection with the operations of the Agricultural Departments in West Africa, and with a view to correlating their work and that of the Imperial Institute, an Inspector of Agriculture for British West Africa (Mr. G. C. Dudgeon) has been appointed, who visits West Africa each year, and on his return has his headquarters at the Imperial Institute.

African Tropical Service Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction in the subject of tropical cultivation and products in this course is given by members of the staff of the Imperial Institute.

Library and Reading-Rooms.—The library and reading-rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference, and are regularly supplied with the more important official publications, and with many of the principal newspapers and periodicals of the United Kingdom, the Colonies, and India.

The library and reading-rooms are on the principal floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute, and of

other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownagree corridor and rooms in connection with this hall are in the occupation of the Indian Section of the Imperial Institute, whilst the hall is available for lectures, meetings, &c.

The "Bulletin of the Imperial Institute" is published quarterly, price one shilling (annual subscription 4*s.* 8*d.*, including postage), and may be purchased at the Imperial Institute or from Messrs. Eyre and Spottiswoode, Ltd., East Harding Street, Fleet Street, London, E.C., or from agents in the Colonies and India. The "Bulletin" contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (vegetable and mineral).

The following societies have their headquarters at the Imperial Institute:—

British Women's Emigration Association.—The British Women's Emigration Association has been assigned an office on the first floor, which is open daily from 10 a.m. to 4 p.m., and advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge. This Association works in co-operation with the Emigrants' Information Office in Westminster.

Colonial Nursing Association.—This Association has been assigned an office on the first floor of the Imperial Institute. Its principal object is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependencies.

African Society.—This Society, which is concerned with the discussion and publication of all matters connected with British African Possessions, has been assigned an office on the mezzanine floor, and holds meetings for the discussion of African questions. The "Journal of the African Society" is published quarterly.

II.—GENERAL.

The present report relates to the principal work which has been carried out in the several Departments of the Imperial Institute during the year 1908, and is in continuation of the Report for 1906-7 (Cd. 3729-48). The nature and importance of the operations of the Institute under the new conditions, which date from the transfer to the Government in 1903, are becoming each year

more generally recognized in the Colonies as well as by the general public and by the commercial community of the United Kingdom, and also by those who are in search of special information relating to settlement, emigration and agriculture. The public galleries and the Reference Sample rooms and laboratories of the Scientific and Technical Department have in addition been visited by officials and others from foreign countries interested in Colonial development.

During 1908 the Transvaal and the Orange River Colony became, as self-governing Colonies, separate contributors to the funds of the Imperial Institute, the Transvaal Government considerably increasing its previous contribution in recognition of the assistance which has been rendered by the Imperial Institute to that Colony, especially in the operations of its Agricultural Department. All the South African Colonies are now represented in the public galleries by collections illustrative of their resources. The Australian States are already separately represented by collections in the public galleries, and also avail themselves of the facilities afforded by the Institute for the conduct of investigations and the supply of special information. During the year the Government of the Australian Commonwealth announced its intention of contributing to the funds of the Imperial Institute.

The control of the Indian Section of the Imperial Institute, which had been previously in charge of a Special Committee and staff, is now merged in the general administration of the Institute, and the reorganisation of the Indian collections on lines similar to those which have been adopted in the case of the Colonies has been commenced, and has already made considerable progress.

Additions have been made to the collections of many of the Colonies, and the technical staff have been continuously engaged in the arrangement and description of new exhibits and in providing tabulated information respecting the present position and resources of the Colonies. Increased interest has been taken by schools and other educational institutions in the Colonial and Indian collections. A number of schools paid special visits to the public galleries, and several loan collections have been formed to further assist schools in the country in teaching the commercial geography of the British Empire. A comprehensive collection of this character was brought together for the Geographical Department of the University of Edinburgh.

It will be seen from the detailed report which follows, that the operations of the Scientific and Technical Department have been very varied in assisting the commercial development of the Colonies and India, in communication with the principal manufacturers and users of raw materials in this country. In addition to the numerous investigations which have been conducted by this Department and the large amount of special information which has been supplied, the staff have also been engaged in the collection and arrangement of all official and published information, including that issued in foreign countries, respecting the progress made in the development of economic resources, vegetable and

mineral. All materials which have been systematically examined and reported on have been added to the special collection which is maintained in the reference sample room of this Department.

In cases in which it appears, from the number of enquiries received, that a demand exists for information on special subjects, articles summarising the information desired have been printed in the quarterly "Bulletin of the Imperial Institute."

The Mercers Company having made a grant for the purpose of assisting the investigations conducted by the Scientific and Technical Department a Mercers Research Followship has been established, the holder of which is to devote himself to investigations of fibrous materials with a view to their employment in the textile and other industries.

At the request of the Secretary of State for the Colonies, arrangements have been made at the Institute for providing special courses of instruction for candidates selected for administrative appointments in West and East Africa. The courses include tropical hygiene, law, accounting and tropical resources, instruction in the last subject being given by members of the Scientific Staff of the Institute, and illustrated by material provided by the Colonial and Indian Collections and the Reference Collections of the Scientific and Technical Department.

The correspondence during the year amounted to 4,693 letters received and 7,218 despatched, of which 393 were reports on investigations conducted in the Scientific and Technical Department.

III.—STAFF.

During the year 1908 the principal members of the staff were as follows:—

Director of the Imperial Institute:—
Wyndham R. Dunstan, M.A., LL.D., F.R.S.

Secretaries to the Director:—
J. H. Preston, M.A. (Oxon.).
Major E. J. Lugard, D.S.O.

SCIENTIFIC AND TECHNICAL DEPARTMENT.

Principal Assistant:—
T. A. Henry, D.Sc. (Lond.). F.C.S.

Senior Assistants:—
H. Brown.
E. Goulding, D.Sc. (Lond.), F.C.S.
G. S. Blake, B.Sc. (Lond.), A.R.S.M., F.C.S.
T. Crook, A.R.C.Sc.I., F.G.S.
A. E. Andrews.

Special Assistants:—
H. H. Robinson, M.A. (Oxon.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.

Assistants:—
S. J. Johnstone.
R. G. Pelly, A.I.C.
S. J. M. Auld, D.Sc. (Lond.), Ph.D. (Würzburg), A.I.C.
F. W. Barwick.
D. A. Bowack (until January, 1908).
S. S. Pickles, D.Sc. (Vict.).
H. E. Watt, D.Sc. (Dunelm).
W. P. Hayworth, A.I.C. (until December, 1908).
A. Jordan, M.Sc. (Leeds), (until September, 1908).
W. R. S. Ladell, A.I.C. (until August, 1908).
J. R. Hill, B.A. (Cantab.).
W. O. R. Wynn.
V. M. Weil, B.Sc. (Lond.).
N. C. Akers, A.I.C.
G. M. Davies.

The special officers of the Mineral Surveys of Ceylon, Southern Nigeria, Northern Nigeria, and Nyasaland, now in progress under the supervision of the Director of the Imperial Institute, and of the preliminary surveys which are being undertaken in British East Africa and Uganda, were:—

Ceylon:—
J. Parsons, B.Sc. (Lond.), F.G.S.
J. A. Daniel, B.A. (Cantab.).

Southern Nigeria:—
A. E. Kitson, B.A. (Melbourne), F.G.S.
S. M. Owen, A.R.S.M. (until July, 1908).
E. O. Thiele, B.Sc. (Melbourne).

Northern Nigeria:—
J. D. Falconer, M.A., D.Sc. (Edin.), F.G.S.
A. Longbottom, B.A. (Cantab.).

Nyasaland:—
A. R. Andrew, B.Sc. (N.Z.), F.G.S.
T. E. G. Bailey, B.A. (Cantab.).

Uganda:—
J. E. Coates, B.A. (Cantab.) (attached to the Anglo-Congolese Boundary Commission).

British East Africa:—
K. H. B. Joll.

Colonial and Indian Collections.

Technical Superintendents:—
W. G. Freeman, B.Sc. (Lond.), F.L.S.
C. H. Nicholls, B.A. (Oxon.), F.L.S.
S. E. Chandler, D.Sc. (Lond.), F.L.S.
H. Spooner.

African Tropical Service Course.

Instructors in Tropical Cultivation:—
W. G. Freeman, B.Sc. (Lond.), F.L.S.
S. E. Chandler, D.Sc. (Lond.), F.L.S.

Instructors in Tropical Products:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
H. Brown.
E. Goulding, D.Sc. (Lond.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
R. G. Pelly, A.I.C.
F. W. Barwick.

IV.—PUBLIC EXHIBITION GALLERIES.

During 1908 great progress was made in improving the Colonial and Indian Collections, and, by means of reorganisation and the receipt of fresh exhibits, the Courts of several Colonies now afford a more adequate representation of their economic position.

The general aim of the collections is both educational and commercial. By the aid of specimens of raw materials, vegetable and mineral, together with maps, statistical diagrams, and photographs they convey to the ordinary visitor, and more particularly to the student and the seeker after special information, an idea of the present condition and the commercial resources of India and the Dominions and Colonies of the British Empire. Schools and other educational institutions, as well as intending settlers and emigrants, are among those who find the Exhibition Galleries of special service and who avail themselves of the assistance of the expert staff which is now attached to the collections, in order to gain further information.

Among the requests for information which have been received are enquiries from manufacturers and users of raw materials respecting the quality and sources of supply of materials exhibited.

The Indian Collections of the Imperial Institute having been merged in the general administration of the Imperial Institute, the East Gallery, containing the Indian exhibits, and the Indian Pavilion were dismantled and redecorated and a complete reorganisation of the exhibits commenced. The Ceylon, Hong Kong, and Malay Courts were also entirely rearranged.

The arrival in London of exhibits from all parts of the British Empire for display at the Franco-British Exhibition at Shepherd's Bush has afforded the opportunity of replenishing many of the courts, and the following countries at the close of the Exhibition transferred exhibits to the Imperial Institute:—

Canada, Gambia, Gold Coast, Southern Nigeria, Mauritius, Natal, India, Western Australia, South Australia, Tasmania, New Zealand, and Fiji.

Other new exhibits have also been received from Canada, British Honduras, British Guiana, Trinidad, Turks Islands, Bahamas, Cyprus, Sierra Leone, Cape Colony, Nyasaland, Sudan, Mauritius, India, Ceylon, Straits Settlements and Federated Malay States, Hong Kong and Victoria.

In connection with the display of these new exhibits, many new descriptive labels, photographs, and statistical diagrams have been added to the public galleries. Descriptive catalogues of the collections of Sierra Leone and Barbados have been prepared and printed in the "Bulletin of the Imperial Institute" Volume VI. (1908), No. 1 and No. 4, respectively, separate copies being available for distribution to applicants at the Central Stand in the galleries.

Many Colonial and Indian exhibits were lent from the collections of the Imperial Institute, at the request of the Governments concerned, to the Franco-British Exhibition, and to the International Rubber Exhibition which was held in London last year, and much assistance was rendered by the members of the staff in the arrangement and display of the exhibits. A large collection of samples of Colonial products has been supplied to the Geographical Department of the University of Edinburgh for use in connection with the teaching of economic geography, and smaller collections have been prepared for schools and educational institutions.

The number of visitors to the Exhibition Galleries during 1908 was 110,189. These included several schools who arranged for special explanations by members of the staff; a party of students from the Handelshochschule of Berlin; and a number of German officials and also a party of some 60 Russian merchants from Warsaw, who were introduced by the Board of Trade.

The Central Stand in the Exhibition Galleries, which serves as a general enquiry office and centre for the distribution of literature regarding the Colonies and India, has during the year distributed to enquirers 9,922 publications.

A large number of verbal enquiries relating to settlement, planting, and products have also been dealt with.

Nearly the whole of the galleries are now filled with the permanent collections of the Colonies and India, and only a part of the North Gallery remains available for temporary exhibitions. Now that so large a part of the North Gallery is occupied by permanent collections, the means of access to it from the Central Gallery requires improvement.

The storage accommodation and working rooms in connection with the collections are becoming more and more inadequate, and although some relief has been afforded by the erection in the South West Quadrangle of a corrugated iron shed, further storage room is much required. It is also desirable that accommodation should be provided at an early date for the Technical Superintendents near the collections of which they have charge, and at the arrangement and description of which they are at work: at present no working rooms contiguous to the respective collections are available for several members of the staff. This is also a disadvantage in answering the enquiries made by visitors.

V.—THE LIBRARY.

Lists of the chief unofficial works added to the Library during the year have been periodically printed in the "Bulletin of the Imperial Institute."

Besides its use by the staff, the Library has been open for use by Life Fellows of the Institute, by enquirers for special information, and by other visitors who are duly introduced.

VI.—"BULLETIN OF THE IMPERIAL INSTITUTE" AND OTHER PUBLICATIONS.

The "Bulletin" is now regularly supplied to the Colonial and Indian Governments and their principal departments. In addition to 1,815 copies thus supplied, 1,606 copies were sold during the year, many firms of manufacturers in this country being among the subscribers.

The following are the titles of the articles which have appeared in the quarterly numbers of the "Bulletin" during 1908:—

Reports on Investigations.

Teas from Natal.
Flax from new sources.
Cottons from India.
Buazé Fibre from Nyasaland.
Rubber of *Ficus elastica* from India.
Rubbers from the Gola Forest, Sierra Leone.
Iron Ore from Natal.
Development of the Resources of the Seychelles.
Jute and Jute Substitutes from West Africa.
Rubbers from Trinidad.
Timbers from Southern Nigeria.
Tin Ores from the Federated Malay States.
Timbers from Uganda.
Fibres from the Gold Coast.
Seeds of *Lophira alata* from Sierra Leone.
Copal Resins from British West Africa.
African Elemi.
Ceara Rubber from Portuguese East Africa.
Rubber of *Forsteronia floribunda* from Jamaica.
Some African Oils and Oil-seeds.
Raphia Wax.
Cotton from British Guiana.
Fibres from Fiji.
"Bitinga" Rubber.

Special Articles.

Uses, Properties, and Production of Gums.
Cotton-Growing in Central Asia.
Weight as a Factor in Seed Selection, with special reference to Cotton Seed.
Ceylon Pearl Fishery.
Phosphate Deposits of Algeria and Tunis.
Production and Utilisation of Wattle Bark.

Special Articles—continued.

Cultivation and Utilisation of Annatto.
Native Leather of West Africa.
Occurrence and Uses of Molybdenum Ores.
Nickel Deposits of Sudbury in Canada.
Oilfields of Trinidad.
Cultivation and Marketing of Maize.
International Rubber Exhibition in London.
Cotton-Growing in the French Colonies.
Experiments in Jute Cultivation in Bengal.
Geranium Oil.
Utilisation of Seal Skins and the Skins of other Aquatic Animals.
Pearl Fishery of Lake Tampalakamam, Ceylon.
Technical Preparation of Asbestos.
Strophanthus Seed.
Flax Cultivation in India.
Notes on the present position of Cotton Cultivation in the United States.

General Notes.

Cocoa from British Honduras.
Sunflower Seed and Oil.
Mauritius Hemp from Uganda.
"Kafumba" Fibre from Uganda.
Wattle Cultivation in German East Africa.
Coca Leaves from Perak.
Senna Leaves from the Sudan.
Hippopotamus Teeth from the Sudan.
Use of Dried Cow-Dung as Fuel in India.
British Cotton Cultivation.
Yebb or Yeheb Nuts from Somaliland.
Origanum Oil from Cyprus.
Ocimum viride from West Africa.
Chlorocodon Roots from Uganda.
Production of Prussic Acid by Rangoon Beans.
Estimation of Orcinol in Orchella Weed.
Recent Developments in the Production of Camphor.
Fibre of *Sida rhombifolia* from India.
Sisal Hemp in German East Africa.
Useful Plants in Madagascar.
Agricultural Experiments in the Congo Free State.
Land for Rubber Cultivation in British Guiana.
Diatomaceous Earth in Ireland.
Geology of the Falkland Islands.
Mineral Production of India during 1906.
Occurrence of Platinum in South Africa.
Fertility of Acid Soils.
Breeding of Plants suitable for growth in Alkaline Soils.
Use of "Prickly Pear" as Fodder.
Fibres from Southern Nigeria.
Australian "Blackboy" or "Grass" Tree (*Xanthorrhœa Preissii*).

General Notes—continued.

Hardwoods of Australia.
Mallet Bark as a Tanning Material.
Export of Tanned Skins from India.
Resources of the Seychelles.
Fruit from British Columbia.
Agriculture in Asia Minor.
Wattle Bark.
Cultivation of Egyptian Cotton in Sind.
Cotton-Growing in Togo.
Progress of Agriculture and Forestry in the Sudan.
Excretion of Toxic Substances by the Roots of Plants.
An Insect Pest of Wheat.

Colonial and Indian Collections.

West African Court. Descriptive Catalogue of the Sierra Leone Exhibits.
Descriptive Catalogue of the Barbados Exhibits.

Other Publications.

Reports issued as Parliamentary Papers in 1908:—

Report on the Work of the Imperial Institute in 1906 and 1907. By the Director. (Cd. 3729-48.)

British Cotton Cultivation: Reports on the quality of cotton grown in British Possessions. By Professor Dunstan. (Cd. 3997, 1908.)

Report on Agriculture in Asia Minor, with special reference to Cotton Cultivation. By Professor Dunstan. (Cd. 4324, 1908.)

Report on the Results of the Mineral Survey of Northern Nigeria, 1904-05. By Professor Dunstan. (Cd. 3914, 1908.)

Report on the Results of the Mineral Survey of Northern Nigeria, 1905-06. By Professor Dunstan. (Cd. 3915, 1908.)

Report on the Results of the Mineral Survey of Nyasaland in 1906-07. By Professor Dunstan. (Cd. 3916, 1908.)

Papers published in Scientific and Technical Journals:—

"The Poisonous Properties of the Beans of *Phaseolus lunatus*, with some observations on Linseed and Cassava." By Professor W. R. Dunstan and Dr. T. A. Henry. (Journal of the Board of Agriculture, 1908, XIV., 722.)

"The Occurrence of Cyanogenetic Glucosides in Feeding Stuffs." By Dr. T. A. Henry and Dr. S. J. M. Auld. (Journal of the Society of Chemical Industry, 1908, XXVII., 428.)

"A New Isomeride of Vanillin occurring in the root of a Species of Chlorocodon." By Dr. Goulding and Mr. R. G. Pelly. (Proceedings of the Chemical Society, 1908, XXIV., 62.)

"The Volatile Oil of the Leaves of *Ocimum viride*." By Dr. Goulding and Mr. R. G. Pelly. (Proceedings of the Chemical Society, 1908, XXIV., 63.)

"A Simple Form of Permanent Magnet suitable for the Separation of Weakly Magnetic Minerals." By Mr. T. Crook. (Geological Magazine, 1908, V., 534.)

"The Meanings and Synonyms of Plumbago." By Dr. J. W. Evans. (Transactions of the Philological Society, 1908, page 133.)

"The Hydrolysis of Amygdalin," Parts I. and II. By Dr. S. J. M. Auld. (Journal of the Chemical Society, 1908, XCIII., 1251, 1276.)

"The Constituents of Cyprus Origanum Oil; isolation of a new terpene (origanene). By Dr. S. S. Pickles. (Journal of the Chemical Society, 1908, XCIII., 862.)

"The Determination of Orcinol in Orchella Weed." By Dr. Watt. (Journal of the Society of Chemical Industry, 1908, XXVII., 612.)

VII.—SCIENTIFIC AND TECHNICAL DEPARTMENT.

The facilities offered by this Department, which were fully described in the Report for 1906-07, have been largely utilised during 1908 for the conduct of investigations and the supply of information respecting the problems of tropical agriculture and the utilisation of raw materials, mineral and vegetable.

The number of investigations and enquiries requested by the Colonies and India in 1908 was 375; the number of reports completed was 393; and at the close of the year 141 investigations were in progress. The subjects which were investigated and on which reports were completed are referred to in the following sections under the headings of the various groups of commercial products to which they related. The countries represented were:—Cyprus, Malta, Egypt, Sudan, Somaliland, Uganda, British East Africa, Zanzibar, Nyasaland, Rhodesia, Natal, Transvaal, Cape Colony, Gambia, Sierra Leone, Gold Coast, Southern Nigeria, Northern Nigeria, St. Helena, Mauritius, Seychelles, India, Ceylon, Straits Settlements, Federated Malay States, Johore, Fiji, Australia, Falkland Islands, West Indies, British Guiana, British Honduras, Bermuda, Newfoundland, Canada, Portuguese East Africa, Madagascar, Norway, Turkey, Greece, Brazil, Mexico, China, Japan, French Dahomey, and Liberia.

Brief allusion may be made here to some of the more important work of this Department during the year.

A very large number of samples of cotton, representing, as a rule, either native cotton or cotton experimentally grown in British Possessions, have been examined and reported on, and several important questions relating to the cultivation and growth of cotton have been dealt with. In connection with the advances which have been made in the tropical Colonies in the successful growth of cotton, it is becoming more and more apparent that in many cases the best results are being obtained by the improvement of native cottons, or cotton already established in the country, rather than in the attempts to establish exotic plants. The probability that this would prove to be the case was emphasised in several publications which have been

issued by the Imperial Institute (*see* especially Professor Dunstan's Report on Cotton Cultivation in the British Empire and in Egypt (1904); Handbook to the Cotton Exhibition, Imperial Institute (1905); British Cotton Cultivation (1908)). It is very desirable that systematic work on this subject, including hybridisation experiments, should be steadily continued in connection with the Agricultural Departments which have now been established by Government in nearly all the tropical Colonies and Protectorates.

The maintenance of a reference collection at the Imperial Institute of standard cottons and of cotton produced in every British Possession has proved of much practical value. It has been largely consulted by those concerned with cotton cultivation and with the cotton industry in this country.

At the instance of the Colonial Office, the Director visited the cotton districts of Asia Minor in 1907, and his report on the growth of cotton in that country and its possibilities was published as a Parliamentary Paper (Cd. 4324, 1908).

Much attention has also been given to fibres other than cotton, and a very large number of samples have been examined and reported on. Cultivation experiments have been conducted in several Colonies in communication with the Institute, with a view to the production of fibres suitable for cordage and as substitutes for jute, especially in West and East Africa. In this subject the Imperial Institute has had the advantage of the cooperation of the principal users of these materials in this country.

Allusion may be made to the experiments now in progress in Sierra Leone and in other parts of West Africa with a view to the growth of species of Hibiscus and other fibres of value as substitutes for jute, and to the attempt which is being made to establish an industry for the growth of New Zealand hemp in St. Helena. In consequence of the continuous demand for information both in this country and in the Colonies respecting the work of the Imperial Institute on commercial fibres, the principal reports which have been made since the issue of the volume of "Technical Reports" in 1903 are now being collected and prepared for publication.

Attention may also be drawn to an interesting investigation which was commenced during the year with a view to determining the commercial possibilities of the "wild silk" produced by species of Anaphe in West and East Africa. In this connection the Institute had the advantage of the great knowledge of the late Sir Thomas Wardle, by whose death the Institute has lost a valuable referee on all matters connected with silk.

Another subject of much importance to several Colonies is the production of tobacco, and this has received considerable attention during the year with the help of the principal tobacco manufacturers in this country. The examination at the Imperial Institute of native and experimentally grown tobacco having indicated the probability of the success of tobacco cultivation in several districts of West and East Africa, the Government

approved the recommendation of the Director that a tobacco expert should be appointed in order to conduct systematic experiments and afford advice in tobacco cultivation and curing in Uganda and East Africa. In both these countries, and especially in the former, the prospects of a tobacco industry are very favourable. Mention may also be made of the success which has attended the growth of tobacco of American and of Turkish type in Rhodesia, and to the satisfactory indications which have been obtained as to the possibility of successful tobacco cultivation in Northern and Southern Nigeria and in Sierra Leone.

The improvement of the native methods of obtaining and preparing "wild" rubber in West Africa has been specially studied, and the question as to the steps which should be taken to secure the adoption of improved methods is under consideration. If better methods were adopted the commercial value of West African rubber would be more than doubled.

One of the principal and most remunerative industries in the coastal regions of West Africa is the production of palm oil, which has long been conducted by the natives, who still employ primitive and wasteful methods. In view of the great demand in Europe for this product, and the probability that important uses can be found for it if prepared in a better manner, an investigation has been commenced at the Imperial Institute in co-operation with the Agricultural Departments of the Colonies concerned with a view to the improvement of this industry. The quantity and quality of the oil furnished by the fruits and kernels of the several varieties of oil palm which occur in West Africa will be determined, and steps will be taken to devise, if possible, a suitable method for the better preparation of the oil from the fruits.

In consequence of representations made to the Imperial Institute by manufacturing firms in this country and abroad as to the increased demand for vegetable oils and fats suitable for the manufacture of butter substitutes, a large number of new and little known oil seeds have been investigated and afterwards submitted to technical trials by manufacturers. An investigation is being conducted for the Government of India in connection with the utilisation of Indian cotton seed oil for similar purposes. A special article summarising the commercial possibilities of a number of new and little-known oil seeds has been printed in the "Bulletin of the Imperial Institute," Vol. VI. (1908), No. 4, pp. 353-380.

The Inspector of Agriculture for British West Africa (Mr. G. C. Dudgeon) has rendered valuable service to the Institute in collecting special information and materials for investigation, and also in directing local enquiries and experimental work in the several West African Colonies. The value of the work of this officer will be greatly enhanced when the Agricultural Departments now in process of organisation are in operation, since these departments will provide the means for systematic and continuous experimental work in agriculture which is necessary for the successful development of these Colonies.

The economic resources of the Seychelles have continued to receive considerable attention, especially in connection with the vanilla industry, the production of essential oils, and the utilisation of tanning materials. A summary of the more important investigations conducted for the Seychelles has been printed in the "Bulletin of the Imperial Institute," Vol. VI. (1908), No. 2, pp. 107-126.

In the subject of minerals much important work has been accomplished during the year, especially through the examination and commercial valuation of the minerals collected during the mineral surveys which are being conducted in several Colonies in co-operation with the Imperial Institute. In addition to the investigations for the surveys in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland, which have been in progress for some years and have been the means of indicating the commercial possibilities of a number of minerals, preliminary surveys were in progress during the year in Uganda and in British East Africa, and these have already afforded evidence that these countries contain deposits which deserve full investigation. The results which have followed from the operations of these surveys clearly demonstrate the advantage of such work being conducted by Government on these lines, by which systematic search for minerals is made in the Colonies, and material collected for research work at the Imperial Institute in communication with technical experts and manufacturers. In Ceylon, where striking results of commercial importance have already been secured, it is clear that much still remains to be done in following up indications obtained of the existence of valuable minerals, and in the technical development of certain deposits by modern methods which have hitherto not been adopted.

In Southern Nigeria attention has been chiefly directed to the occurrence of lignite and its possibilities as a fuel. The mineral surveyors have made a thorough exploration of the deposits, and the value of the material and the best modes of utilising it are being very fully investigated at the Imperial Institute. In view of the observations which have been made so far, it seems not improbable that the lignite deposits of Southern Nigeria may prove a valuable asset not merely for the Colony, but as a source of fuel for the whole of West Africa. A series of clays from Southern Nigeria has also been fully examined to ascertain their value for the local manufacture of pottery by the natives.

In Northern Nigeria the mineral surveyors have, in addition to other work, located and explored new or little-known deposits of tinstone, which proved on examination at the Imperial Institute to be of excellent quality. There can now be little doubt that tin mining will become in the future one of the principal industries of this country.

In Nyasaland the location of deposits of excellent coal and also of graphite are among the more important results of the work of the mineral survey. One of the deposits of graphite is now

being opened out by a firm of manufacturers with the advice of the Imperial Institute.

A detailed examination and a series of technical trials have been made of a large series of clays specially collected in India with a view to ascertaining their value for the local manufacture of pottery.

A most interesting series of specimens of tin ores were received for examination from the Federated Malay States, in which the tinstone was deposited in limestone; the latter proved to be sufficiently phosphatic to be of value as an artificial manure.

Reports on the results of the mineral surveys in Northern Nigeria and in Nyasaland have been issued as Parliamentary Papers during the year.

SUMMARY OF INVESTIGATIONS.

Minerals.

Countries of origin.—Cyprus, Egypt, British East Africa, Nyasaland, Uganda, Rhodesia, Natal, Transvaal, Cape Colony, Northern Nigeria, Southern Nigeria, Sierra Leone, Seychelles, India, Ceylon, Straits Settlements, Federated Malay States, Fiji, Australia, Falkland Islands, West Indies, Newfoundland, Canada.

Number of minerals received in 1908	2,792
Number of minerals reported on in 1908	516

Mineral Surveys.

The mineral surveys in Ceylon, Southern Nigeria, Northern Nigeria, and Nyasaland, which are being carried on in these countries in connection with the Imperial Institute, were continued during 1908, as was also the collection of minerals by the mineralogist appointed to accompany the Anglo-Congolese Boundary Commission and by the mining expert appointed by the Government of British East Africa. From all these countries large numbers of minerals of probable economic importance were received for examination and report at the Imperial Institute.

Ceylon.—A report was made to the Government of Ceylon on the results of the examination of a number of "concentrates," containing thorianite and monazite, prepared from river gravels, as part of a systematic examination of certain rivers in Ceylon for valuable minerals. A specimen of native copper from Pelmadulla was nearly pure metal. Among other minerals received and examined were wollastonite, moonstone, thorite, and clays. The minerals under examination at the end of the year included concentrates containing gold and thorium-bearing minerals, corundum, limestones, water from mineral springs, guano, &c.

Southern Nigeria.—The minerals collected during 1906-7 were examined during 1908, and at the end of the year a report on

them was in preparation. The samples include a very interesting series of lignites, all of which are suitable for use as fuels, and some of which yield on destructive distillation illuminating gas almost as good in quality as that obtained from English coal. The lignite deposits of Southern Nigeria are now known, as the result of the survey's work, to be very extensive, and some of them are close to existing means of transport, so that they represent an asset of great value to the Colony. Steam-raising trials are now being made with the lignite in the Colony, and briquetting trials are under consideration.

A large number of concentrates from river sands were received, some of which were found to contain gold. The quantity present, however, is small, though in some cases the gold might be worth working by natives.

A series of pottery clays was examined. Many of these were of excellent quality and suitable for the production of well-coloured and durable pottery. Pottery clays are not likely to be remunerative as an export product from Southern Nigeria, but are of interest as materials for local industries. Samples of salt of native manufacture were also received. These were remarkably pure for native salts and contained over 96 per cent. of true salt (sodium chloride). A number of samples obtained in the course of boring operations for bitumen and petroleum in the Colony were also reported on during the year.

Northern Nigeria.—The minerals collected by the mineral surveyors during the year 1907-08 were examined. In addition to specimens from new and important occurrences of tin ore, the minerals included a large number of iron ores, most of which were too impure to be suitable for smelting directly, but might be purified magnetically to yield good ores. A few were of excellent quality, and from these good iron could be prepared by native methods. Several limestones proved to be suitable for the production of lime for ordinary mortar and for agricultural purposes. Most of the concentrates contained small quantities of monazite, and in a few cases fair quantities of this mineral and of tinstone. In general, however, the gravels and sands in the areas explored are too poor to be worth working for these minerals. A number of native salts were examined, but were of poor quality as condiments, containing more sodium sulphate than sodium chloride. A lead silver ore proved to contain 69·1 per cent. of lead and 69·5 oz. of silver per ton.

A small pocket of argentiferous quartz, such as is found from time to time in Northern Nigeria, was discovered during the year. A specimen of this contained 39·0 per cent. of silver.

Nyasaland.—The specimens collected by the mineral surveyors during 1906-7 were examined and a report was issued at the beginning of 1908 and has been printed as a Parliamentary Paper (Cd. 3916, 1908). The most important minerals described were limestones, iron ores, graphites, coals, galena, and corundum, and some of these were of very promising character. The minerals collected during 1907-08 were examined during 1908 and a report is in preparation. They include a large number of coals

from various coalfields in Northern Nyasaland, which were explored by the surveyors during the year. These deposits of coal, though at present somewhat inaccessible, represent an asset of great value for the future of the country.

A large number of limestones were also examined, some of which proved to be suitable for the manufacture of hydraulic cements. The concentrates received were of little value, containing mostly magnetite and ilmenite with, in a few cases, monazite and tinstone. A few of them contained gold, but the area from which these were obtained is small and not likely to be worth working.

The most interesting find during the year was a deposit of flake graphite, which proved on examination to be of high quality. A British firm has sent out an expert to inspect the deposit with a view to working if it proves to be sufficiently extensive.

Anglo-Congolese Boundary Commission.—The mineralogist appointed to accompany the Commission sent a number of minerals for examination but of these comparatively few were of direct economic interest, though they included ironstone, mica, and other minerals, indicating that the mineral resources of Uganda might repay fuller investigation.

British East Africa.—Among the minerals collected by the mining expert to the Government were copper ores, limestones, manganese ore, and auriferous quartz. The manganese ore was of very good quality. The specimens received from British East Africa are sufficient to indicate that the mineral resources of the country merit thorough investigation.

Miscellaneous Minerals.

Cyprus.—Magnesite of very good quality was received.

British East Africa.—In addition to the minerals referred to under Mineral Surveys, a number of soils was received for mechanical and chemical analysis and, on the basis of the results, recommendations were made for the manurial treatment of the soils. Other samples were papyrus ash, proposed for use as a manure, and a diatomite (kieselguhr) of good quality.

Uganda.—The minerals received from Uganda in connection with the Anglo-Congolese Boundary Commission are mentioned under Mineral Surveys. Apart from these a number of samples of salt and of salt-impregnated earth, used by the natives as a source of salt, were examined.

Rhodesia.—The minerals received included asbestos, graphite, soils, mica, corundum, and magnesite. The last two were of promising quality.

Natal.—Several graphites were reported on. A memorandum dealing with the demand for and value of titanium minerals was supplied to the Natal Government.

Transvaal.—An ornamental stone was examined and the opinion of experts obtained as to the possibility of its being used in this

country for decorative purposes. Chrome iron ore was also received for examination.

Cape Colony.—A number of specimens of rock supposed to contain platinum were received and examined. Some of these contained traces of platinum too small to be of economic importance (*see* "Bulletin of the Imperial Institute," 1908, VI., 312). A concentrate which proved to contain tinstone, wolfram, and magnetite was also examined. Information was supplied regarding the value and demand for molybdenum ores.

Sierra Leone.—The minerals received from this Colony included a complex ore containing gold, silver, copper, zinc, &c., and it was suggested that the occurrence of this should be investigated more fully. Further specimens of the iron ore referred to in the Report on the work of the Imperial Institute during 1906-07, (p. 31) were received but proved to be much inferior to the first sample. Two clays were examined, one of which was fire-resistant and suitable for firebricks.

India.—The examination of the series of pottery clays referred to in the report for 1906-07, p. 32, was completed, and a detailed report, giving analyses of certain selected clays and the results of firing and pottery trials, was made to the Indian Government. A number of samples of graphite, mica, and other minerals were examined and valued, and short memoranda on the occurrence of magnesite and wolfram, &c. in India were supplied to enquirers in India.

Straits Settlements and Federated Malay States.—The minerals received were of considerable economic interest; they included three limestones carrying respectively 2·14, 0·25, and 0·12 per cent. of tinstone. One of them was also sufficiently phosphatic for the residue left after the removal of the tinstone to be employed as a manure. A full account of these tinstone-carrying limestones is given in the "Bulletin of the Imperial Institute," 1908, VI., 155.

Other samples were a zircon sand, and a rather poor manganese ore. At the end of the year, four concentrates containing gold, tinstone, monazite and other minerals were under examination. Information was also supplied to firms in the United Kingdom during the year on the production of wolfram in the Federated Malay States.

Australia.—The minerals examined included ilmenite, containing the rare mineral carnotite, from South Australia and a clay of good quality from Western Australia.

West Indies.—A sample of remarkably pure salt from Turks Island was received for examination.

Newfoundland.—Certain kinds of kelp from Newfoundland were found to be unusually rich in potash and in iodine. Further consignments have been asked for, with a view to ascertaining the commercial possibilities of the material.

A considerable number of enquiries, relative to the occurrence, supply, demand and prices of various minerals, were received from firms in the United Kingdom and in the Colonies and India, and also from British firms in foreign countries.

Fibres (including Cotton).

Countries of Origin.—Cyprus, Sudan, British East Africa, Nyasaland, Uganda, Rhodesia, Natal, Transvaal, Cape Colony, Gambia, Gold Coast, Sierra Leone, Southern Nigeria, Northern Nigeria, St. Helena, India, Ceylon, Johore, West Indies, British Guiana, British Honduras, Bahamas, Australia, Fiji, Turkey-in-Asia, China.

Number of fibres received in 1908	292
Number of fibres reported on in 1908	292

Cotton.

The work on the systematic examination of cotton has been continued on the same lines as in previous years.

Natal.—Three samples were added to the reference collection.

Transvaal.—Three samples were added to the reference collection.

Uganda.—In connection with an enquiry as to whether the cotton grown in Uganda has deteriorated, a large number of samples of lint and seed were examined. The results indicated that no serious deterioration had occurred since 1905, but the samples submitted were very small, whilst those grown in 1905 were themselves stained and of somewhat poor quality. At the close of the year, twenty samples of cotton of the last season's growth were under investigation. On the whole the cotton produced in Uganda is of good quality and appears to be susceptible of considerable improvement.

Rhodesia.—A sample of a consignment of brown Egyptian cotton which was sold at 8*d.* per lb. (with "fully good fair" brown Egyptian at $7\frac{5}{16}$*d.* per lb.) was found to be of excellent quality.

British West Africa.—Fifteen samples from the Gold Coast were of marketable quality, but mostly stained. It was recommended that greater care should be exercised in the cultivation and means adopted to combat the ravages of insect pests. Two additional samples were placed in the reference collection. At the end of the year, twelve samples from the Gold Coast remained under investigation.

Among the samples from Southern Nigeria, there were several American Upland varieties which were of good quality and equal or somewhat superior to ordinary "middling" American cotton.

A sample from Northern Nigeria was similar in appearance to a low grade of brown Egyptian, but was rougher and inferior in colour. It was considered that it might be utilised as a substitute for Peruvian cotton and was valued at 7*d.* per lb. (with "good fair" moderately rough Peruvian at $10\frac{1}{2}$*d.* per lb.).

India.—A sample of "kidney" tree-cotton from Sambalpur was of good quality and likely to find a market as a rough, long-stapled cotton of Peruvian character. It was valued at about 9*d.* per lb., with "good fair" moderately rough Peruvian at

9¾*d.* per lb. A specimen of short-stapled cotton from Tenasserim, Burma, was of excellent quality and equal in value to "fine" machine-ginned Broach. Summaries of recent reports on Indian cottons have been published in the "Bulletin of the Imperial Institute." 1908, VI., 11.

British Guiana.—Several samples were examined and found to be of good, saleable quality. Special interest attached to a series of varieties grown by the aboriginal Indians on the savannahs, which have been cultivated so long as to be practically indigenous. These cottons were mostly of a character resemoling that of Brazilian cotton, and were of useful quality and worth from 7*d.* to 8*d.* per lb. A summary of the reports on these samples has been given in the "Bulletin of the Imperial Institute," 1908, VI., 383.

British Honduras.—A sample resembling an "improved" American Upland cotton was of good quality and worth 5¼*d.* per lb., with "middling" American at 4·95*d.* per lb.

Australia.—Four samples from Queensland were added to the reference collection.

Fiji.—Two samples were added to the reference collection.

Asia Minor and Syria.—Thirty samples, including lint, bolls, seed, and cloth, collected by the Director of the Imperial Institute during a mission of enquiry undertaken for the Colonial Office, were examined. These consisted of (1) native "Yerli" cotton, which was rough and woolly, but rather short as a substitute for Peruvian or Brazilian; (2) American varieties which were nearly equal in quality to those grown in the United States; and (3) Egyptian "Abassi" of promising quality. Some of these cottons are described in a "Report on Agriculture in Asia Minor" by Professor Wyndham Dunstan (Cd. 4324, 1908).

Jute and Similar Fibres.

Natal.—A sample of fibre, the botanical source of which is at present unknown, resembled jute, but was somewhat harsh. The strength was uneven and rather poor, probably owing to the fibre having been over-retted. Value, about £14 per ton (11th September, 1908). Samples of jute and the fibre of *Pavonia columella* were also examined and found to be of comparatively poor quality.

Cape Colony.—A sample of "marsh mallow" fibre consisting of nearly white, fairly lustrous ribbons was weak and brittle, and nominally worth about £10 per ton (3rd March, 1908).

British West Africa.—A specimen of the fibre of *Urena lobata* from the Gambia was only half as long as ordinary jute, but was otherwise of excellent quality and suitable for use as a jute substitute. It was valued at £17 per ton, with "medium" jute at £15-£17 per ton.

Three samples of "Okra" fibre (*Hibiscus esculentus*) received from Sierra Leone were said to have been extracted after the collection of the first, second, and third crop of fruit respectively. They were regarded as worth about £14, £18 to £20 and £15 per

ton, with "medium" jute at £14 to £16 per ton. That obtained after the collection of the second crop of fruit was of excellent quality. A sample received at a later date, which had been prepared after the third crop of fruit, was of good quality, and decidedly superior to the previous sample collected at the corresponding period. Two samples of "Napunti" fibre (*Honckenya ficifolia*) were of comparatively poor quality.

Five samples of jute from Southern Nigeria were examined, three of which were of good quality and equal in value to "medium" Calcutta jute. A specimen of "Ramo" fibre (*Hibiscus* sp.) was of useful quality, and resembled China jute (*Abutilon Avicennæ*), which was then quoted at £17 10*s.* per ton.

Strips of the bark of a species of *Hibiscus* received from Northern Nigeria were only suitable for paper-making, and would probably be worth about £4 per ton. A sample of "Ramma" fibre (*Hibiscus lunariifolius*) was examined and found to be of similar character to jute but much harsher, and therefore more suitable for utilisation by rope-makers than jute spinners. Value, £12 per ton (14th February, 1908).

India.—A specimen of the fibre of *Sida rhombifolia* was fine, silky, and of excellent quality. It was regarded as suitable for mixing with silk, and also as readily saleable for the finest purposes to which jute is applied, and was valued at £25 to £30 per ton, with "good" to "fine" jute at £16 to £25 per ton. The cultivation of the plant was recommended.

Western Australia.—An enquiry was received from Western Australia with reference to the effect of an infusion of "jarrah" sawdust in rendering jute bags resistant to the attack of "superphosphate" manure.

Manila Hemp.

India.—Manila hemp, grown at Kullar in the Nilgiris, was well prepared, but weaker and softer than ordinary Manila hemp and more like banana fibre. It was regarded as suitable for binder twine and worth £23 to £24 per ton (8th October, 1908).

West Indies.—A specimen of Manila hemp, grown in Trinidad from seed imported from the Philippines, was of good colour, lustre, and strength, and worth £30 per ton, with "fair current" Manila at the unusually low market value of £25 per ton.

"Aloe" Fibres (Agave, Sansevieria, and Furcræa).

Sudan.—A small specimen of Sansevieria fibre from the Bahr-el-Gebel was well cleaned and of good colour, but of irregular length, varying from 2 feet to 4 feet. If of regular length, about 4 feet, the fibre would have been readily saleable at about £30 per ton.

Nyasaland.—A sample of Sisal hemp, grown in the Government Experimental Gardens at Zomba, was under investigation at the end of the year.

British East Africa.—A sample of Sisal hemp of very good strength, length, and quality was examined. It was reported by commercial experts to be of the same character as German East

African Sisal, and worth £29 per ton (with Mexican Sisal at £24 per ton).

Rhodesia.—Four samples of "aloe" fibre, resembling the fibre of *Sansevieria guineensis*, were badly prepared, but if better cleaned, lustrous, nearly white, and not less than three feet long, would have been worth about £25 per ton.

Sierra Leone.—A specimen of the waste obtained during the extraction of the fibre of *Sansevieria guineensis* was examined. It was short, tangled, weak, of uneven quality, and worth about £10 to £12 per ton.

India.—Two samples of Agave fibre, received from Assam, had not been well cleaned, but, if properly prepared and not less than 4 feet long, would have been worth about £30 per ton.

A sample of Sisal hemp from Port Blair, Andaman Islands, was of good colour, length, strength, and lustre and worth about £24 per ton, with Mexican Sisal at about £25 per ton.

Johore.—Samples of Sisal hemp, Mauritius hemp, "American aloe" fibre, and the fibre of *Sansevieria guineensis*, *S. sulcata*, and *S. zeylanica* were received from Johore. These products had been prepared from the leaves of plants only six months old, and were consequently too short and weak to be of much value.

Bahamas.—Six samples of Sisal hemp were examined and submitted to users of this material. At present Bahamas Sisal is shipped almost entirely to the United States.

Fiji.—Samples of Sisal, Mauritius, and Bowstring hemps which had been perfectly cleaned and were of excellent quality were valued at £34 to £35, £31, and £27 per ton respectively. A sample of "American aloe" fibre remained under investigation at the close of the year. A summary of the report on these fibres from Fiji has been published in the "Bulletin of the Imperial Institute," 1908, VI., 387.

Numerous enquiries were received with reference to the cultivation and extraction of fibres of this class, and the required information was supplied in each case.

New Zealand Hemp (*Phormium tenax*).

St. Helena.—Samples of the first three shipments of New Zealand hemp from St. Helena were examined. They consisted of clean fibre, of good colour, lustre, and length. The strength of the samples was compared with that of a standard "good fair" New Zealand hemp as 100, and found to be 75, 80, and 60 respectively. The comparative weakness of the third shipment was regarded as probably due to over-preparation. The pulpy waste obtained during the extraction of the fibre was investigated, and reports on the possibility of utilising it were made. An enquiry was also dealt with relating to the manuring of fibre plants.

Ramie (*Boehmeria nivea*).

Fiji.—Ramie "ribbons," cleaned by the Death and Ellwood machine, were examined and regarded as worth about £25 per ton, with hand-cleaned China grass at £25 to £30 per ton. A

specimen of well-cleaned filasse was also examined. Two further samples were under examination at the close of the year.

Several enquiries on ramie and the methods of its extraction were received and answered.

Flax.

Cyprus.—Samples of flax were examined which were short and incompletely retted. Suggestions for improvement were made.

British East Africa.—A sample of flax grown in the Highlands was coarse, of poor colour, and worth about £18 to £20 per ton.

India.—At the request of the India Office, a study was made of the conditions under which the strength of flax canvas is tested. Since the strength varies greatly with the moisture present, it was recommended that all strength tests should be accompanied by moisture estimations in order that corrections may be made for the excess or deficiency of moisture above or below a certain specified standard. Suggestions were made as to the methods of carrying out these tests.

Enquiries were received on the subject of retting systems and the methods of combating attacks of the flax dodder, and the desired information was given.

A report on a number of samples of flax from new sources has been published in the "Bulletin of the Imperial Institute," 1908, VI., 4, and an article on flax cultivation in India appears on pp. 401-404 of the same volume.

Flosses or Silk-Cottons.

British East Africa.—A sample of floss from an Asclepiadaceous plant was found to be suitable as a substitute for "kapok," but was somewhat stained and contained a small quantity of seed. It was valued at 5¾*d.* per lb., but would have been of greater value if free from seed and stains.

Uganda.—A specimen of soft, fairly resilient floss, containing a large quantity of seed, was examined. If free from seed it would probably have been worth 4*d.* to 5*d.* per lb.

Wool and Goats' Hair.

Uganda.—A sample of goats' hair was under investigation at the close of the year.

India.—Two samples of wool from the Central Jail, Coimbatore, were examined. One of these, from a cross-bred sheep, was of a mixed and irregular type and worth 10*d.* to 1*s.* per lb. Recommendations were made that great care should be taken in breeding, and that a cross-bred sheep, bred in a merino country, should be employed instead of the pure merino for crossing with the Indian sheep. The other specimen was of similar character, but of a brown colour and therefore worth only about 6*d.* to 8*d.* per lb.

Silk.

Uganda.—Technical trials of Uganda wild silk (*Anaphe* spp.) were in progress at the end of the year.

Nyasaland.—A sample of *Anaphe* wild silk cocoons was received and examined.

Transvaal.—Ten samples of Bombyx silk cocoons were examined and valued. Certain defects were pointed out and remedies suggested.

Southern Nigeria.—Samples of wild silk cocoons, used by the natives for making "soyan" cloths, were examined. The product was of good quality, but somewhat stained. It was suggested that the silk should be carefully sorted, the stained portions excluded, and the chrysalides removed without being crushed.

Northern Nigeria.—A mass of cocoons of *Anaphe Moloneyi* was examined. It was found that, like other varieties of *Anaphe* silk, the product could not be reeled, but might be carded and spun. It was suggested that a few hundredweights should be forwarded for spinning trials. At the end of the year, a sample of cocoons, found on a thorn-bush near Zungeru, was under investigation.

Ceylon.—A sample of "Eri" cocoons was examined. Commercial experts reported that the silk could be carded and spun, and if sent in sufficient quantity would be in good demand and worth about 1*s.* 6*d.* per lb. Samples were also submitted to Continental spinners, and it was suggested that a trial consignment should be forwarded for sale.

China.—Specimens of cocoons and silk gut were forwarded through the Chinese Legation. The silk of the cocoons was coarse, harsh, and of no value for spinning. The silk gut was weak, and lacking in smoothness, transparency and regularity of diameter, and was therefore regarded by experts as of no commercial value.

Miscellaneous fibres.

Rhodesia.—Five samples were received from North-Western Rhodesia. No. 1, "Chinsange" somewhat resembled Asclepias fibre but was short (2 feet) and badly prepared. No. 2, "Gonafa Tantoala," was of promising quality but only 10 inches to 13 inches long; if longer, it might possibly be of value as a hemp substitute. Nos. 3 and 4, "Kongye Difa" and "Kongye Mangya," were probably Sansevieria fibres; they were fairly well cleaned but too short (22 inches) to be of much value. No. 5, "Mtamsa," was of no value.

A sample of "Nkungadzi" fibre, from Southern Rhodesia, was unlignified and very strong. If obtainable of a length of 4 feet, it would be useful for rope-making at about £30 per ton.

A specimen of the fibre of the "Gwenderi" plant (probably *Xysmalobium* sp.) was white and fairly strong but only 2 feet long.

Natal.—A sample of the fibre of a species of *Asclepias* was nearly white but not very well cleaned. If more carefully cleaned, it would be worth about £20 to £25 per ton.

Sierra Leone.—A sample of pineapple fibre was received which was 3 to 4 feet long, of fair but uneven strength and nominally worth about £25 to £30 per ton.

Southern Nigeria.—Ten samples of fibrous material were received of which only one, "Ikan" cane (*Oncocalamus acanthocnemis*) was likely to be of value for export. This product might possibly find a market for basket-making, and it was suggested that a few bundles of 100 canes, 8 to 10 feet long, should be forwarded for technical trial.

Eighteen samples were forwarded by the Forestry Department and included several native fibres which could probably be used for rope-making: such as "Lagbo-lagbo" (£22 to £24 per ton); "Eso," *Sterculia Barteri* (£15 to £20 per ton); *Eriodendron anfractuosum* (£18 to £19 per ton). There were also two jutes of good quality, and samples of *Furcraea gigantea* (about £28 per ton), *Sansevieria guineensis* (about £28 to £30 per ton), two jute-like fibres, "Esuya" and "Akeri" (£10 and £13 to £14 per ton) and a sample of ramie.

India.—A sample of the fibre of *Dregea volubilis* was examined. It was badly cleaned and contained adherent woody tissue. The fibre substance itself, however, was not lignified.

Ceylon.—An enquiry, accompanied by a sample, was received with reference to the possibility of utilising the fibre from areca-nut husk. Commercial experts reported that it was of no value as a substitute for coir, but might possibly be used as a stuffing material or for paper-making. It was recommended that a trial shipment should be made in order to test the market.

Australia.—A sample of prickly-pear fibre from New South Wales was examined. It was found to be useless for any purpose except possibly for paper-making. The cellulose content, however, was very low (58 per cent. on the dry material) and the ultimate fibres were very short (0·012 to 0·032 inch), and it was considered that the price obtainable for the material would not be likely to repay the cost of collection, preparation, and shipment.

Enquiries with reference to the utilisation of this product were also received from the Transvaal and St. Helena.

Rubber.

Countries of Origin.—India, Gambia, Sierra Leone, Gold Coast, Southern Nigeria, British East Africa, Zanzibar, Nyasaland, Rhodesia, Transvaal, Cape Colony, Seychelles, West Indies, British Guiana, Portuguese East Africa.

Number of rubbers received in 1908	...	...	40
Number of rubbers reported on in 1908	...	...	94

The attention which has been devoted to rubber and its cultivation during recent years in nearly all the tropical Colonies and

Protectorates shows no sign of diminution, and the number of specimens reported on by the Imperial Institute during 1908 slightly exceeded the figures for 1907. In addition to the examination of samples of rubber much information and advice have been supplied to Colonial Governments, planters, and enquirers in this country on points connected with the cultivation of rubber-yielding plants or with the collection and preparation of rubber.

India.—Specimens of Para, Castilloa, Ceara, and Ficus rubbers prepared in India were reported on during 1908.

Para rubber (*Hevea brasiliensis*). The specimens submitted for examination were prepared at the Government experimental gardens at Kullar and Burliar, in the Nilgiri Hills. The rubber from both sources was very satisfactory in chemical composition, comparing favourably in this respect with plantation Para rubber from Ceylon, but it was rather deficient in strength The specimen from Burliar was much lighter in colour than that from Kullar and was consequently valued at a higher price, the quotations being 5*s.* 4*d.* to 5*s.* 5*d.* per lb., and 5*s.* to 5*s.* 2*d.* per lb. respectively, with plantation Para biscuits at 5*s* 3*d.* to 5*s.* 9*d.* per lb.

Castilloa rubber (*Castilloa elastica*). Specimens of this rubber were also received from Kullar and Burliar. The rubber from Kullar was of inferior quality on account of the large amount (32·5 per cent.) of resin present. The trees from which the rubber was obtained were, however, only six years old, and it is probable that the quality of the rubber will improve as they become older. The specimen from Burliar contained much less resin than that from Kullar (about 13 per cent.) and was greatly superior in physical properties. It was valued at 3*s.* 6*d.* to 3*s.* 8*d.* per lb. in London with fine hard Para at 5*s.* 1*d.* per lb., whilst 3*s.* 2*d.* to 3*s.* 4*d.* per lb. was quoted for the specimen from Kullar.

Ceara rubber (*Manihot Glaziovii*). A specimen of Ceara biscuit rubber from Kullar was of good quality, containing 82·5 per cent. of caoutchouc and exhibiting very satisfactory physical properties. It was valued at 5*s.* 6*d.* per lb., with Para biscuits quoted at 5*s.* 3*d.* to 5*s.* 9*d.* per lb. A sample of Ceara rubber from South Arcot was much inferior in composition to the preceding specimen, containing only 73·7 per cent. of caoutchouc and a high percentage of proteid. It was valued at 2*s.* 5*d.* per lb. when fine hard Para stood at 3*s.* 5½*d.* per lb.

Ficus elastica rubber. Two specimens of this rubber, one in biscuit form and the other in scrap, were forwarded from Mukkie in the Kanoth Range, North Malabar. Both samples contained a large amount of resin and were somewhat deficient in elasticity and tenacity. The biscuit rubber, which was almost black, was valued at 2*s.* 6*d.* per lb., and the reddish scrap rubber at 2*s.* 11*d.* per lb. with fine hard Para at 3*s.* 5½*d.* per lb.

Gambia.—The investigation of the rubber of *Ficus Vogelii* from the Gambia has been continued, and during 1908 a small consignment was received for technical trial. The rubber was of resinous nature, containing from 30 to 35 per cent. of resin, but as the result of trials by manufacturers it was found to be suitable for certain technical purposes. The washed rubber was

valued at from 1*s.* 7*d.* to 1*s.* 11*d.* per lb., with fine hard Para quoted at 2*s.* 9*d.* per lb.

Sierra Leone.—Ten specimens of rubber from Sierra Leone were reported on during 1908; they included samples of Funtumia, Landolphia and Ficus rubbers. The Funtumia rubber was of good quality, the dry product containing 87 per cent. of caoutchouc, but the biscuits were of rather rough appearance. It was valued at 3*s.* per lb., with fine hard Para at 3*s.* 5½*d.* per lb.

A number of samples of Landolphia rubber were examined. The well-prepared rubber was found to be of good quality, containing nearly 90 per cent. of caoutchouc in the dry material, and it was valued at the same price as the preceding specimen of Funtumia rubber.

A specimen of rubber obtained from a species of Ficus was found to contain 37 per cent. of resin, and was therefore of inferior quality. It was very similar in composition to the *Ficus Vogelii* rubber from the Gambia, and would realise about the same price.

Gold Coast.—A number of specimens of Funtumia and Landolphia rubbers from the Gold Coast were reported on during 1908.

A sample of *Funtumia elastica* rubber, coagulated by means of an infusion of the leaves of *Bauhinia reticulata*, was received from Ashanti. It was of good quality, containing 88·5 per cent. of caoutchouc, but the sheets were of rather rough appearance and not thoroughly dried. It was valued at 2*s.* 8*d.* to 2*s.* 10*d.* per lb., with fine hard Para quoted at 3*s.* 5½*d.* per lb.

Three other specimens of Funtumia rubber from Ashanti had been prepared by "creaming" the latex. They were of very good quality so far as chemical composition is concerned, containing from 88·5 to 89 per cent. of caoutchouc and low percentages of resin and proteid. The commercial value of the samples was however reduced by the facts that the cakes had been made too thick and contained a considerable amount of moisture; they were also of rather rough appearance. The specimens were valued at from 2*s.* 7*d.* to 2*s.* 10*d.* per lb., with fine hard Para at 4*s.* 6*d.* per lb.

A fifth sample of Funtumia rubber from Ashanti had been prepared in biscuits by the spontaneous coagulation of the latex. It was much less satisfactory in chemical composition than the preceding specimens, containing only 71·5 per cent. of caoutchouc and large amounts of resin and proteid. It was however much superior in appearance, and was valued at 3*s.* 6*d* to 3*s.* 8*d.* per lb., with fine hard Para quoted at 4*s.* 6*d.* per lb.

A specimen of "Pempeneh" rubber, derived from *Landolphia owariensis* growing in the Northern Territories, was found to be of very good quality, containing 90·6 per cent. of caoutchouc, 6 per cent. of resin, and less than 1 per cent. of proteid. It was valued at 3*s.* to 3*s.* 3*d.* per lb., with fine hard Para at 3*s.* 5½*d.* per lb.

Six specimens of latex and two samples of Ficus rubber received from an estate near Axim were examined. The Ficus

rubbers contained 22 and 27 per cent. of resin, and were therefore of inferior quality. Samples of Ficus latex which were stated to correspond to the specimens of prepared rubber were found to yield products of similar character. A specimen of Landolphia latex, probably from *L. owariensis*, yielded rubber of good quality, but the other latices, stated to be derived from species of Landolphia, Tabernæmontana, and Anthostema, and from *Funtumia africana*, furnished resinous products of no commercial value.

A substance resembling gutta percha, derived from the rhizomes of a plant occurring in the Colony, was also investigated.

Southern Nigeria.—A number of specimens of *Funtumia elastica* rubber prepared in biscuits or sheets have been received for examination and valuation in comparison with the ordinary lump rubber as prepared by the natives. One sample, described as "Anyo" rubber, was in the form of dark-coloured biscuits which had been imperfectly dried, and consequently arrived in a mouldy condition. The rubber was of good quality, containing 86·5 per cent. of caoutchouc, and was valued at 2*s.* 6*d.* to 2*s.* 8*d.* per lb., with fine hard Para quoted at 3*s.* 5½*d.* per lb. Samples of Benin lump rubber sent at the same time were valued at from 1*s.* 6*d.* to 1*s.* 11*d.* per lb.

Three further samples of Funtumia rubber in biscuit form were forwarded from Benin City. They were of satisfactory composition, containing from 87·9 to 89·8 per cent. of caoutchouc, but were of very rough appearance. They were valued at from 2*s.* 8*d.* to 3*s.* 4*d.* per lb., with fine hard Para at 4*s.* 6*d.* per lb., and Benin lump at 2*s.* per lb.

A specimen of "Ubabikpan" rubber derived from *Clitandra elastica* was found to be of very good quality, containing 90·4 per cent. of caoutchouc whilst the percentages of resin and proteid were low. It was valued at 2*s.* 8*d.* to 2*s.* 10*d.* per lb., with fine hard Para at 3*s.* 5½*d.* per lb.

A sample of rubber derived from the Marodi vine consisted of a thick rough biscuit of brown rubber, dry and well prepared. It contained over 80 per cent. of caoutchouc, but a rather large amount of proteid. It was valued at 2*s.* 6*d.* per lb., with fine hard Para at 3*s.* 1*d.* per lb.

A specimen of rubber believed to have been prepared from *Ficus elastica* was found to be very satisfactory in chemical composition, but deficient in physical properties. On the latter account its commercial value was only low.

East Africa Protectorate.—The examination of a small ball of Ceara rubber from the Kibos district showed that the percentages of resin, proteids and insoluble matter were all rather excessive. It was valued at about 3*s.* per lb., with fine hard Para at 4*s.* 3½*d.* per lb.

Zanzibar.—Small samples of Para and Castilloa rubbers experimentally prepared in Zanzibar were received for examination.

The Para rubber was of very good quality but contained a fair amount of vegetable impurity and a little more resin than usual.

The Castilloa rubber was of very resinous nature containing only 77 per cent. of caoutchouc and 20·5 per cent. of resin. No information was available as to the age of the trees from which the specimen was obtained. The samples were too small for valuation.

Cape Colony.—A specimen of coagulated latex received from Cape Colony was found to contain 64 per cent. of resin, and would therefore have very little, if any, commercial value. It was probably derived from a species of Euphorbia.

Rhodesia.—A sample of Ceara rubber from North Eastern Rhodesia proved to be of inferior quality on account of the large percentage of sand it contained; otherwise it was of normal composition and was valued at 1*s.* 8*d.* per lb., with fine hard Para at 3*s.* 5½*d.* per lb.

A specimen of so-called rubber was also received from Southern Rhodesia. It proved to be a resinous product, resembling the material obtained from species of Euphorbia in South Africa.

Seychelles.—Specimens of Para and Vahea rubber were received from Seychelles for examination.

The three samples of Para rubber were obtained from a small number of trees under five years old, but of considerable size. The rubber was very satisfactory in composition, comparing favourably in this respect with Para rubber from Ceylon and the Federated Malay States, but was deficient in strength. The latter defect was probably chiefly due to the fact that the rubber had been obtained from young trees. From the results of the chemical examination however there appears to be every likelihood that the Para trees in Seychelles will yield excellent rubber as they become older.

The Vahea rubber, derived from a climbing plant introduced from Madagascar was of good quality, the best specimen containing 91 per cent. of caoutchouc, but the cost of preparing the rubber in a clean form is practically prohibitive.

Jamaica.—A sample of the rubber of *Forsteronia floribunda*, a climbing plant occurring in Jamaica, was found to be of good quality, containing 88·8 per cent. of caoutchouc. It was valued at 2*s.* 4*d.* per lb., with fine hard Para at 3*s.* 5½*d.* per lb.

British Guiana.—The rubber obtained from *Sapium Jenmani* in British Guiana has been carefully investigated in order to determine its composition and value. A number of specimens, in the form of biscuits, scrap block, and ball, have been analysed, and the results show that the rubber is of very good quality so far as chemical composition is concerned. The percentages of caoutchouc recorded range from 87 to 92 per cent. and of resin from 2·0 to 4·2 per cent.; the best specimen contained 92·4 per cent. of caoutchouc, 2 per cent. of resin and 2·8 per cent. of proteid. The following valuations were obtained: scrap block from 2*s.* 4*d.* to 3*s.* per lb.; balls 2*s.* 6*d.* per lb.; and the best

biscuits 3*s.* 6*d.* per lb., with fine hard Para at 3*s.* 5½*d.* per lb. There is therefore no longer any doubt that the rubber yielded by this tree is of excellent quality if carefully prepared.

A sample of balata from British Guiana was of very good quality, containing 50·7 per cent. of gutta and 44·8 per cent. of resin. The percentage of gutta is higher than that usually recorded for balata. The specimen was valued at 2*s.* 2½*d.* per lb. The latex of the Bastard Bullet tree was found to yield a product containing 70·6 per cent. of resin, therefore differing widely in composition from true balata.

Portuguese East Africa.—Specimens of Ceara, Landolphia, and Mascarenhasia rubber from Portuguese East Africa proved to be of good quality, whilst the products obtained from *Ficus* sp., *Landolphia florida* and *Diplorrhynchus mossambicensis* were of resinous nature and of little or no value.

An examination has also been made of Bitinga tubers (*Raphionacme utilis*) and the rubber they furnish. The partly dried tubers as received contained from 1·0 to 1·5 per cent. of rubber, corresponding to a yield of 9·3 to 11·6 per cent. from the dry material. The sample of prepared rubber was of very fair quality, but was rather sticky and contained a considerable amount of vegetable and mineral impurity. Trials are being made to ascertain whether the tubers of this plant, which is stated to flourish on poor soils not adapted to other rubber plants, can be profitably utilised as a source of rubber.

Timbers.

Countries of Origin.—Sudan, British East Africa, Rhodesia, Northern Nigeria, Southern Nigeria, Sierra Leone, Gold Coast, Gambia, Mauritius, India.

Number of timbers received in 1908	62
Number of timbers reported on in 1908... ...	34

Sudan.—Of these timbers only one, *Soymida roupalifolia*, was regarded as suitable for export. It is a beautiful wood with parallel dark lines, of high decorative value, and suitable for use as cedar or mahogany.

British East Africa.—These were samples of the sapwood and heartwood of the so-called "Ibean camphor tree." No indication of the presence of camphor could be obtained.

Mauritius.—These were all timbers suitable for local use, but not possessing distinctive characters likely to make them available for export.

Among the other woods were mahogany from Northern Nigeria and Gambia, having the ordinary characters of West African mahogany, and readily saleable when exported in large logs; boxwood from India and "Mashuna" wood from Rhodesia. At the end of the year there remained under examination a series of large samples of the principal timbers of the Gold Coast collected by Captain Armitage, and a memorandum was in prepara-

tion for the Government of Mysore on the production, use, and value of the sandalwood obtained from other countries than India. During the year a chemical examination into the nature of the constituents of East and West Indian satinwoods, which cause dermatitis in workmen engaged in working with these timbers, was continued.

Oils and Oil-Seeds.

Countries of Origin.—Sudan, British East Africa, Uganda, Rhodesia, Transvaal, Sierra Leone, Gold Coast, Southern Nigeria, Northern Nigeria, India, Federated Malay States, West Indies, British Guiana, Australia, Fiji, Portuguese East Africa, Mexico.

Number of oils and oil-seeds received in 1908 ...	66
Number of oils and oil-seeds reported on in 1908 ...	53

Fruits and Seeds of Balanites ægyptiaca.—A sample of "Heglig" (*Balanites ægyptiaca*) fruits was received from the Sudan. The oil from the seed-kernels was regarded by experts as equal in value to refined cotton-seed oil, but the commercial prospects of the fruits were not considered to be very favourable, owing to the difficulty of extracting the kernels. The latter would probably be worth about £5 or £6 per ton. Samples of the oil and seeds from Northern Nigeria were also examined. As the oil of *Balanites ægyptiaca* is reputed by the natives of Uganda to be of value as a remedy for sleeping sickness, specimens of the fruits and oil were submitted to pharmacological tests, which, however, gave negative results.

Fruits, Seeds, and Oil of Bassia spp.—Samples of the fruits, seeds, and fat of *Bassia latifolia* and *B. longifolia*, and of the seeds and fat of *B. butyracea* from India were examined, and results were obtained which were fairly in accord with those of previous observers, and showed that the fats would be of value for edible use or for soap-making.

Beeswax.—Samples of beeswax from the Sudan and the Gold Coast were examined and found to be of good quality.

Seeds of Carapa spp.—Seeds of *Carapa procera* from Sierra Leone were found to yield an oil which was valued at £20 10*s.* per ton, whilst the seed-kernels were regarded as worth about £10 per ton

A sample of the seed of *Carapa grandiflora*, from Uganda, furnished an oil valued at £24 to £26 per ton. The seed-kernels were considered to be worth £5 to £6 per ton, assuming that the cake could be sold at £2 per ton.

Castor Oil Seeds.—Castor oil seeds from North-Western Rhodesia were of good quality, and were regarded by manufacturers as worth 5*s.* per ton more than East Indian castor seed. At the end of the year, three samples from Fiji were under investigation.

Dika Nuts.—Five samples of Dika nuts were received from Southern Nigeria. Experts reported that the fat obtainable

from these seeds possessed a value equal to that of palm-kernel oil (£27 5*s*. per ton), and stated that Dika kernals would be readily saleable. Unfortunately, however, the nuts do not appear to be obtainable in large quantities at a low cost.

Lophira alata Seeds.—Three consignments of the seeds of *Lophira alata* were received from Sierra Leone. The oil was valued by experts at £1 or £2 per ton in advance of cotton-seed oil.

Mafoureira Seeds (*Trichilia emetica*).—Samples of Mafoureira seeds were received from the Transvaal and Portuguese East Africa. The seeds were submitted to experts for technical trial. The fat, however, proved to be dark coloured and difficult to bleach, and was therefore unsuitable for the better qualities of soap, and would only realise the price of a "soft, off-coloured tallow." The cake is unsuitable for feeding purposes, as it is bitter and, probably, emetic. A price of £9 5*s*. per ton has been offered for the seeds in this country.

Omphalea megacarpa Seeds.—The seeds of *Omphalea megacarpa* were found to yield a pale yellow, faintly bitter oil, which is less viscous than castor oil and differs to some extent in its chemical constants. The pharmacological activity of the oil has been studied by Professor Cash, F.R.S., who regards it as a valuable, non-irritant cathartic.

Para Rubber-seed Oil (*Hevea brasiliensis*).—Samples of Para rubber seeds and oil were received from the Federated Malay States. The results of their examination confirmed the opinion that the oil could be used for the same purposes as linseed oil. A ton of oil, or five tons of undecorticated seeds, was requested for technical trials on a manufacturing scale.

Pycnanthus Seeds and "Mace."—Samples of the nuts and mace of *Pycnanthus Schweinfurthii* were received from Uganda. The seed-kernels yielded a dark brown, solid fat, which would need to be refined before it could be used for soap-making. A firm of soap manufacturers reported that probably the nuts could not be utilised commercially unless they are obtainable in very large quantities at a low cost. The "mace" furnished a dark orange-red oil, which can only be decolorised by means of alkali, involving the removal of the large amount of free acids present, and it therefore seems unlikely that the mace could be used commercially as a source of oil.

Ricinodendron Heudelotii Seeds.—These seeds from Southern Nigeria were found to furnish a rapidly drying oil. A consignment was submitted to a firm of varnish makers, who made careful technical trials with the oil and arrived at the conclusion that its properties are intermediate between those of T'ung oil and linseed oil, and that it would be suitable as a substitute for the former. It appears somewhat doubtful, however, whether the collection and exportation of the seeds would prove remunerative.

Among other products examined, may be mentioned Shea butter nuts from the Sudan, seeds of *Croton macrostachys* from Uganda,

COLONIAL REPORTS—ANNUAL.

No. 584.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, 1906 AND 1907.

(For Report for 1905, *see* [Cd. 3116] 1906.)

Presented to both Houses of Parliament by Command of His Majesty
November, 1908.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY DARLING & SON, LTD., 34-40, BACON STREET, E.

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1908.

[Cd. 3729-48.] *Price* 4*d*.

No. 584.

IMPERIAL INSTITUTE, 1906 AND 1907.

(For Report for 1905, *see* [Cd. 3116] of 1906.)

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, IN 1906 AND 1907. By PROFESSOR WYNDHAM R. DUNSTAN, M.A., LL.D., F.R.S., *Director.*

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I.—PREFATORY STATEMENT.

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The Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May, 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of India and the Colonies, and providing for their investigation and for the collection and dissemination of scientific, technical, and commercial information relating to them.

The work of the Imperial Institute is at present carried on under four principal divisions: (1) The Colonial and

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Indian collections, consisting mainly of raw materials and primary manufactures displayed in the public exhibition galleries, and including a central stand for receiving enquiries and distributing publications; (2) the Scientific and Technical Department, including a special staff and research laboratories occupying the second floor of the building; (3) the Reference Library, containing a large collection of works of reference relating to India and the Colonies, together with the principal periodicals and newspapers; (4) the "Bulletin of the Imperial Institute," a quarterly publication including a record of the work of the Imperial Institute in its various branches, as well as special articles on subjects connected with the industrial utilisation of mineral and vegetable products.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which His Royal Highness the Prince of Wales (now His Majesty the King) was President, and an Executive Council, including representatives of the Indian Empire and of all the British Colonies and Dependencies. In 1900 the building became the property of His Majesty's Government, by whom the western portion and galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portions being assigned for occupation by the University of London. In July, 1902, an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee, including representatives of India and the Colonies, as well as of the India and Colonial Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A Committee of Management of three members, one nominated by each of the three Government Departments chiefly concerned, has been appointed.

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and to the commercial utilisation of economic products.

The following are the principal departments of the Institute:—

Colonial and Indian Collections.—The collections of economic products, &c., illustrative of the general and commercial resources of India and the Colonies, are arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday, and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter.

Special arrangements are made for the conduct of schools and institutions desirous of visiting the Indian and Colonial collections for educational purposes.

A stand has been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Pamphlets, circulars, handbooks, &c., containing information relating to the commerce, agriculture, mining, and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. The principal Indian and Colonial newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the departments in the main building.

The Scientific and Technical Department.—The research laboratories of this department, which occupy the second floor of the Imperial Institute, were established in order to provide for the investigation of new or little-known natural products from India and the Colonies, and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade, and industries of India and the Colonies.

The work of this department is chiefly initiated by the Government of India and the Home and Colonial Governments. Arrangements have been also made by the Foreign Office, whereby British representatives abroad may transmit to the department for investigation such natural products of the countries in which they are appointed to reside as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the department, and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

Except under special circumstances investigations are not undertaken for private individuals.

A Reference Sample Room is maintained in this department, in which are arranged samples of the principal materials

which have been investigated and commercially valued during recent years, and as to which full information is available.

The Scientific and Technical Department is now working in co-operation with the Agricultural and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations and inquiries as are of a special scientific and technical character connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial value of products (vegetable and mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of India and the Colonies, a first instalment of which has been printed in a volume of "Technical Reports and Scientific Papers," published in 1903, whilst a selection of the later reports has been printed in the "Bulletin of the Imperial Institute."

Mineral surveys, under the supervision of the Director of the Imperial Institute, and conducted by surveyors selected by him, are in progress in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland, and preliminary arrangements of a similar nature have been made in connection with British East Africa and with the Anglo-Congolese Boundary Commission in Uganda. All minerals found are forwarded to the Imperial Institute, where they are examined and, in all cases in which they are likely to be of commercial importance, their composition and commercial value are ascertained. Reports by the Director on the results of the mineral exploration in Ceylon, Northern Nigeria and Southern Nigeria have been printed in the Miscellaneous Series of Colonial Reports.

In connection with the operations of the Agricultural Departments in West Africa, and with a view to correlating their work and that of the Imperial Institute, a Superintendent of Agriculture for British West Africa has been appointed, who visits West Africa each year, and on his return has his headquarters at the Imperial Institute.

Library and Reading-Rooms.—The library and reading-rooms of the Imperial Institute contain a large collection of Indian and Colonial works of reference, and are regularly supplied with the more important official publications, and with many of the principal newspapers and periodicals of the United Kingdom, India, and the Colonies.

The library and reading-rooms are on the principal floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute, and of other persons properly introduced. Books

and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three large rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

Cowasjee Jehanghier Hall.—The Bhownagree corridor and rooms in connection with this hall are in the occupation of the Indian Section of the Imperial Institute, whilst the hall is available for lectures, meetings, &c.

The "Bulletin of the Imperial Institute" is published quarterly, price one shilling (annual subscription 4*s.* 8*d.*, including postage), and may be purchased at the Imperial Institute or from Messrs. Eyre and Spottiswoode, East Harding Street, Fleet Street, London, E.C., or from agents in India and the Colonies. The "Bulletin" contains records of the principal investigations conducted for India and the Colonies at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (vegetable and mineral).

The following societies have their headquarters at the Imperial Institute:—

British Women's Emigration Association.—The British Women's Emigration Association has been assigned an office on the first floor, which is open daily from 10 a.m. to 4 p.m., and advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge. This Association works in co-operation with the Emigrants' Information Office in Westminster.

Colonial Nursing Association.—This Association has an office on the first floor of the Imperial Institute. Its principal object is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependencies.

African Society.—This Society, which is concerned with the discussion and publication of all matters connected with British African Possessions, has been assigned an office on the mezzanine floor, and holds meetings at the Imperial Institute for the discussion of African questions. The "Journal of the African Society" is published quarterly.

II.—GENERAL.

The present report deals with the work which has been carried out in each division of the Imperial Institute during the years 1906 and 1907, supplementing the report for 1905 (Cd. 3116 of 1906). It will be seen that the considerable increase in the work of the Imperial Institute recorded in the last report has continued.

In connection with the transfer of the management of the Institute to the Colonial Office in 1907 new arrangements were made by Lord Elgin, then Secretary of State for the Colonies, for the participation of the Colonies in the work of the Imperial Institute, with the result that new collections have been added to the Exhibition Galleries and numerous additional requests for information and investigations have been made to the Scientific and Technical Department. Owing to the large increase in work in all departments the space in the Imperial Institute building which was retained under the arrangement made by the Government in 1900 is no longer adequate, and some additional accommodation has now been provided by a temporary building in the south-west quadrangle which will shortly be supplemented in other ways. It is satisfactory to notice that without any special advertisement and in spite of the inconspicuous entrances, commented upon in the body of this report, the number of visitors to the Exhibition Galleries has very considerably increased, and that the majority of these visitors were genuine enquirers, including a number of schools and educational institutions, many of which made special arrangements for the exhibits illustrating the resources of the British Possessions to be explained in detail. Assistance in this and other ways has been given to the Victoria League and to other bodies which are engaged in Imperial educational work.

The work accomplished by the Scientific and Technical Department for the Colonies and India is recorded in considerable detail in the following pages. It will be seen that this has included investigations in connection with the production and utilisation of every variety of raw material, mineral and vegetable, whilst special information has been supplied on these and similar subjects to manufacturers and others, and this information, in cases in which it seemed desirable, has been made the basis of special articles in the "Bulletin of the Imperial Institute," which now has a wide circulation both in British Possessions and abroad. A number of the more important reports on investigations conducted in the Scientific and Technical Department have also been printed in the "Bulletin," whilst a large number of papers communicating the results of scientific investigations have been published by the Royal Society and other scientific societies.

The large amount of correspondence, &c., entailed by the work of the several sections of the Imperial Institute has been for the most part conducted in the general office by the clerical staff, which has found it difficult to cope with the great increase in this work, and in the collateral work of registration, filing, indexing, &c., which has occurred during the period under review. In addition to minor correspondence which it is convenient to conduct through the department

concerned, and to that of the Indian Section, which has been carried on by a separate staff, the work of the general office included the despatch during 1906 of 7,033 letters and reports, whilst 4,426 letters were received. Of the documents despatched, 282 were detailed reports on special investigations conducted by the Scientific and Technical Department. During 1907, 7,392 documents were despatched, of which 398 were reports on investigations, whilst 4,704 letters were received. The increase in correspondence which occurred during the two years reflects the general increase of the work of the Institute which has taken place in all sections, especially in that of the Scientific and Technical Department.

III.—STAFF.

During the years 1906 and 1907 the principal members of the staff were as follows:—

Director of the Imperial Institute:—
Wyndham R. Dunstan, M.A., LL.D., F.R.S.

Secretary to the Director:—
J. H. Preston, M.A. (Oxon.).

SCIENTIFIC AND TECHNICAL DEPARTMENT.

Principal Assistant:—
T. A. Henry, D.Sc. (Lond.), F.C.S.

Senior Assistants:—
H. Brown.
E. Goulding, D.Sc. (Lond.), F.C.S.
G. S. Blake, B.Sc. (Lond.), A.R.S.M., F.C.S.
T. Crook, A.R.C.Sc.I., F.G.S.

Special Assistants:—
H. H. Robinson, M.A. (Oxon.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.

Assistants:—
A. E. Andrews (Salters' Research Fellow).
J. W. G. Brooker, A.I.C. (until July, 1906).
S. J. Johnstone.
R. G. Pelly, A.I.C.
S. M. J. Auld, Ph.D. (Würzburg), A.I.C.
F. W. Barwick.
D. A. Bowack.
S. S. Pickles, M.Sc. (Vict.).
T. C. Thomas (until December, 1906).
R. W. Blair, A.R.C.Sc.I. (until August, 1906).
H. E. Watt, M.Sc. (Dunelm).
W. P. Hayworth, A.I.C.
A. Jordan, M.Sc. (Leeds).
W. R. S. Ladell, A.I.C.

The special officers of the Mineral Surveys of Ceylon, Southern Nigeria, Northern Nigeria, and Nyasaland, now in progress under the supervision of the Director of the Imperial Institute, and of the preliminary surveys which are being undertaken in British East Africa and Uganda, were:—

Ceylon:—

A. K. Coomaraswamy, D.Sc. (Lond.), (until December, 1906).
J. Parsons, B.Sc. (Lond.), F.G.S.
J. A. Daniel, B.A. (Cantab.).

Southern Nigeria:—

J. Parkinson, B.A., B.Sc. (Cantab.), (until September, 1906).
L. H. L. Huddart, M.A. (Cantab.), A.R.S.M. (until June, 1906).
A. E. Kitson, B.A. (Melbourne), F.G.S.
I. A. Stigand, B.A. (Cantab.), A.R.S.M. (until August, 1907)
S. M. Owen, A.R.S.M.

Northern Nigeria:—

J. D. Falconer, M.A., D.Sc. (Edin.), F.G.S.
D. R. Home (until September, 1906).
A. Longbottom, B.A. (Cantab.).

Nyasaland:—

A. R. Andrew, B.Sc. (N.Z.), F.G.S.
T. E. G. Bailey, B.A. (Cantab.).

Uganda:—

J. E. Coates, B.A. (Cantab.), (attached to the Anglo-Congolese Survey Commission).

British East Africa:—

K. H. B. Joll.

Colonial and Indian Collections.

Superintendent of Colonial Collections:—

W. G. Freeman, B.Sc. (Lond.), F.L.S.

Assistant Superintendents:—

C. H. Nicholls, B.A. (Oxon.), F.L.S.
S. E. Chandler, D.Sc. (Lond.), F.L.S.
E. H. Wilson (until November, 1906).
H. Spooner.

Superintendent of Indian Section:—

C. E. Jones, B.Sc. (Lond.), F.L.S.

IV.—EXHIBITION GALLERIES.

During the period under review considerable progress has been made in re-organizing these collections on a definite plan, a large work which was commenced in 1903. The aim

has been, whilst preserving the original geographical scheme of arrangement preferred by India and the Colonies, to render the collection or "court" of each country an object lesson of its present economic condition; the raw materials, mineral and vegetable, exported by the country or used in its industries or manufactures furnishing the nucleus of each collection. Maps, statistical diagrams and photographs are freely employed as aids to a clear understanding of the present condition and characteristics of each British Possession, whilst by means of specially prepared descriptive labels the chief facts of importance connected with each exhibit are concisely summarised.

The descriptive labels summarising the nature, production, and uses of materials, on the preparation of which special care has been bestowed, have attracted the attention of a number of museums, both in this country and abroad. Specimens of the labels have been supplied at the request of Colonial museums in Germany, France and Belgium, whilst the West Indian Exhibition Committee has asked permission to reprint several of the labels, and has recommended the adoption of similar labels in future in all exhibitions of West Indian products. The collections are thus made to serve several purposes. To the ordinary visitor to the public galleries they convey an attractive and instructive illustration of the leading characteristics of the condition and resources of each British Possession; they serve important educational purposes, especially in connection with the teaching of the geography of the British Empire, and are now visited by a number of schools and educational institutions; whilst they also serve as a guide to the intending emigrant or settler, and also to the manufacturer as an index of the chief resources of each country, and as the starting point of technical inquiries and laboratory investigations, which are dealt with by the expert staff of the Institute, as well as a means of displaying and illustrating the results of these investigations.

Attached to these collections is a special technical staff, consisting of the superintendent and three assistant superintendents. This staff is charged with the general work connected with the arrangement and care of the collections, and it assists, in co-operation with the staff of the Scientific and Technical Department, in answering inquiries and supplying information required by visitors and correspondents. The Indian collection has occupied a distinct position, under the charge of a special superintendent, who, whilst subject to the Director and the general regulations of the Institute, acted as Secretary to the Indian Committee, through which the Indian Section was administered. Besides the technical staff there are attendants who are on duty in the galleries when they are open to the public, in addition to those employed in the general duties of care and maintenance.

The following British Colonies and Dependencies are represented by collections in the public galleries:—

Canada, Newfoundland; Jamaica, Turks Islands, British Honduras, British Guiana, Bahama Islands, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda Islands; Falkland Islands; Australia: New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, New Zealand; Fiji; Cape of Good Hope, Natal, Transvaal, Orange River Colony, Rhodesia, Nyasaland; St. Helena; Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria; British East Africa, Zanzibar and Pemba; Uganda; Somaliland; the Anglo-Egyptian Soudan; Malta; Cyprus, Ceylon, Hong Kong; Mauritius; Seychelles; Straits Settlements and Federated Malay States; and India.

During the period the general improvement of the public galleries was continued. Redecoration of the galleries was carried out on an extensive scale, necessitating the dismantling and subsequent re-arrangement of nearly all the Colonial Courts, which through their re-organization and the additions that were made now give a much more adequate representation of the economic resources and present condition of the Colonies and Protectorates. New exhibits have been received from the West and East African Colonies and Protectorates, Zanzibar, Hong Kong, Ceylon, the West Indies, the Straits Settlements and Federated Malay States, the Falkland Islands, New South Wales and New Zealand, whilst new collections have been received from the Cape, Natal, and for the new courts for the Orange River Colony and the Transvaal. A particularly fine collection illustrating the resources of the Dominion of Canada has been arranged in the Canadian Section under the auspices of the Canadian Government. In connection with the re-arrangement of the collections there has been included a number of Royal presents from the Colonies, lent by His Majesty the King and Their Royal Highnesses the Prince and Princess of Wales. Their inclusion has greatly added to the general interest and attractiveness of the public galleries.

In the arrangement of the British East Africa Court great assistance was rendered by Mr. H. Powell, Assistant to the Director of Agriculture of the Protectorate, who spent three weeks at the Imperial Institute for the purpose. Mr. H. G. Smith, F.C.S., the Assistant Curator of the Sydney Technological Museum, also afforded help in connection with the arrangement of additional specimens of eucalyptus oils in the New South Wales Court. In the West African Section great assistance was rendered by Mr. W. R. Elliott, late Forestry Officer in Northern Nigeria, who was temporarily attached to the collections staff.

The following is a summary of the work which has been carried out in the principal sections of the exhibition galleries during 1906 and 1907:—

India.—Important groups of exhibits have been re-arranged and added to, new labels provided, as well as maps and statistical tables. The entire section is in process of re-arrangement.

Canada.—An entirely new collection has been installed by the Canadian Government.

Ceylon.—New exhibits have been received, including a comprehensive exhibit illustrating the pearl industry, a series of photographs illustrating rubber cultivation and preparation, and a map showing rubber areas. Every industry of the first rank in Ceylon is now well represented in the court.

Australia.—Maps and statistical tables have been added to certain of the Australian courts. Descriptive labels have been prepared, and many of the collections re-arranged and photographs added.

West Indies.—A large number of new exhibits have been added.

Transvaal and Orange River Colonies.—Courts containing illustrations of the resources of these Colonies have been arranged.

Rhodesia.—New exhibits of the resources of Rhodesia have been provided by the British South Africa Company.

Natal.—Many new exhibits have been supplied by the Government of the Colony.

East and West Africa.—Additional exhibits sent from the individual Colonies and Protectorates, and several maps have been included in these collections. A model of a gold dredger was presented by the African Gold Dredging and Mining Concessions, Limited. The principal resources of each of the Colonies and Protectorates of East and West Africa are now shown.

Sudan.—A collection representing the resources of the Sudan is being provided.

Important additions, as well as re-arrangement and relabelling, have been also made in courts belonging to Hong Kong, the Straits Settlements and Federated Malay States, Cape Colony, Falkland Islands, and Zanzibar.

A collection of British minerals, received from the Home Office, was arranged in the galleries.

Descriptive catalogues of the collections of New Zealand, East Africa, Nyasaland, Northern Nigeria, Gambia, and Sierra Leone have been prepared and printed in the "Bulletin of the Imperial Institute," separate copies being available for distribution. Catalogues of other collections are in course of preparation.

The number of visitors to the collections in 1906 was 80,020, and in 1907 123,016, which is the highest number recorded since

1903. These included many schools, for whom special arrangements were made by which members of the staff accompanied each party and afforded additional information. In the same way the services of certain members of the staff have been available on one afternoon in each week during the year to conduct visitors and to give explanations. A visit was paid by members of the Iron and Steel Institute and the American Institute of Mining Engineers on the occasion of their joint meeting in London in July, 1906.

When completely re-organized these collections will, it is hoped, attract visitors in increasing numbers on a scale corresponding with those who now resort to the neighbouring Victoria and Albert Museum and the Natural History Museum. Some steps are, however, still needed to make the public collections more widely known, and among these may be mentioned the provision of better and more conspicuous public entrances.

The central stand, which serves as a general enquiry office in the public galleries and a means of regulating the distribution of literature relating to India and the Colonies, has proved to be a useful feature. 8,759 publications were distributed to enquirers during the year 1906, and 14,866 during 1907. 193 special enquiries, chiefly relating to emigration, settlement, planting, climate, agriculture, and forestry, were dealt with by the expert staff in 1906, and 217 in 1907.

Owing to the interest created by the Cotton Exhibition, which was held during the summer of 1905 in the North Gallery, and the numerous requests for information which have been since received, some of the more important cotton exhibits have been placed permanently on view in the North Gallery and additions have been made during 1906 and 1907. A very comprehensive collection of British-grown cottons is now on view.

The extension of the colonial collections in order to include the new exhibits which have been received has necessitated the installation of several courts in the North Gallery, which was formerly reserved for temporary exhibitions and other uses. Half the North Gallery is now occupied in this way by the permanent collections of the Colonies. The remaining portion is still reserved for special exhibitions, &c. Among these temporary exhibitions may be mentioned that of students' work in technology and handicraft held under the auspices of the Technological Department of the City and Guilds of London Institute, including specimens of the work done in several technical schools in the Colonies which had been sent to London for examination.

Loan collections of specimens of economic products have been lent from the galleries to several exhibitions, notably the Liverpool Colonial Products Exhibition, the South African Products Exhibition held in London, the Health,

Food, and Hygiene Exhibition at the Crystal Palace, and the exhibitions held by the Royal Horticultural Society, whilst a number of schools and educational institutions have been supplied with small collections illustrative of the resources of the British Colonies for use in connection with the teaching of geography.

Several of the Crown Colonies find it convenient to make the Imperial Institute a centre from which special exhibits of their resources may be arranged by the technical staff and sent to any exhibition held in this country in which these Colonies may desire to participate. There is a pressing need for further storage accommodation in connection with the Exhibition galleries, the existing accommodation being now entirely inadequate.

V.—THE LIBRARY.

Besides its constant use by members of the staff, the Library has been used during the year by Life Fellows of the Institute as well as by enquirers for special information.

The facilities afforded by the Library and rooms of the Imperial Institute have been utilized during the year by a number of officers of the Colonies and Protectorates at home on leave, who have also been given every facility for pursuing enquiries in connection with the Colonial collections and the work of the Scientific and Technical Department.

VI.—"BULLETIN OF THE IMPERIAL INSTITUTE" AND OTHER PUBLICATIONS.

The "Bulletin" has already a large and inc .sing circulation in Great Britain, the British Colonies, and also in foreign countries In addition to exchanges for other publications, over 3,000 copies were sold during 1907, and the subscribers include numerous manufacturing and commercial firms in this country interested in the utilization of raw materials.

The following are the titles of the reports and special articles which appeared in the four numbers of the "Bulletin" for 1906:—

Reports on Investigations.

Timbers from the British East Africa Protectorate.
"Dika Nuts" from Southern Nigeria.
Cotton from British North Borneo.
Agave and Furcræa Fibres from Madras.
Rubbers from Sierra Leone.
Tanning Materials of the Soudan.
Castor Oil and Ground Nut Oil from Southern Rhodesia.
Tobacco from Jamaica.
Dammar Resins from the Federated Malay States.
Rocks and Minerals from British Central Africa.
Sansevieria Fibres from British East Africa.
Tobacco from British Honduras.
Inoy Kernels from West Africa.
Rubbers from Uganda.
Minerals from Cyprus.
China Clay from Queensland.
Cotton Cultivation in British East Africa.
Origanum Oil from Cyprus.
Cape Berry Wax from Cape Colony.
Occurrence of Monazite in the Tin-Bearing Alluvium of the Malay Peninsula.

Special Articles.

Indian Aconites and their Poisonous Constituents.
The Australian Pearl-Shell Fishery.
Insects Which Attack Cotton in Egypt.
The Maple Sugar Industry.
Mica in Canada.
Gold Dredging in California.
The Guayule Rubber of Mexico.
Recent Progress in the Practice of Green Manuring.
The Seaweed Industry of Japan.
Production and Uses of Mohair.
Mineral Production in India.
Coalfields of Cape Colony.
Occurrence of Platinum.
Production and Uses of Oil of Turpentine.
Recent Work on African Rubber Vines.
Nigerian Sorghum in Queensland.
Recent Developments in German East Africa.
Geology of Togoland.
Occurrence and Uses of Corundum.
Classification of Coals.
British Association, 1906. Presidential Address to the Section of Chemistry and Agricultural Science.
Cyanogenesis in Plants.
Chemical Research in the Dutch Indies.
Improvement of West African Cotton.
The importance of Humus in Tropical Agriculture with special reference to Cocoa.
Graphite and its Uses.

The following are the titles of the reports and special articles which appeared in the four numbers of the "Bulletin" for 1907:—

Reports on Investigations.

Fibres of British West Africa.
Oil Beans from Southern Nigeria.
Latex and Rubber of *Parameria glandulifera* from India.
Copal Resin from the Gold Coast.
Yebb Nuts from Somaliland.
Kola Seeds from the Gold Coast.
Cocoa from Uganda.
Ginger from Sierra Leone.
Timbers from the Mabira Forest, Uganda.
Occurrence of Indigo in the "Gara Plant" of Sierra Leone.
Tobacco from Northern Nigeria.
"Ikpan" seeds from Southern Nigeria.
Seeds of *Aleurites Fordii* and *Aleurites triloba* from Hong Kong.
Chromite and Other Minerals from Rhodesia.
Economic Products from British East Africa.
Para Rubber from the Federated Malay States.
Rubbers from the Gold Coast.
Peat from the Falkland Islands.
Iron Ore from Parapara, New Zealand.
Tanning Materials from various Colonies and Protectorates.
Cocoa from the Gold Coast Colony.
"Nsa-Sana" Seeds from Southern Nigeria.
Para Rubber from the Mergui Plantation, Burma.
Cryptostegia grandiflora Rubber from India.
Jute Substitutes from the Nyasaland Protectorate.
Silk Cocoons from Uganda.
Materials for Cement Manufacture from Trinidad.

Special Articles.

Sansevieria and Agave Fibres in East Africa.
Cotton-Growing in Spain.
New Zealand Hemp.
The Rubber Exhibition in Ceylon.
Recent Developments in Portuguese East Africa.
Hardwoods of Western Australia.
Graphite: Its Occurrence and Uses.
Insects and other Cotton Pests, and the Methods suggested for their Destruction.
Sources, Manufacture and Industrial Uses of Alcohol.
Geological Structure of Trinidad.
Alluvial Tinstone Deposits of Northern Nigeria.
Vegetable Products of Kontagora Province, Northern Nigeria.

Special Articles—continued.

Extension of the Cultivation of Jute and similar Fibres in India.
Cotton-Growing in Algeria.
Manganese Ores: their Uses, Occurrence, and Production.
Fuel Resources of Canada.
The Sponge Industry.
Ceara Rubber in Portuguese East Africa.
Recent Developments in German East Africa.
Occurrence and Uses of Tantalum Ores.

Other Publications.

The reports on investigations conducted in the Scientific and Technical Department, referred to in the following pages, have been usually made to the Governments of the Colonies and Protectorates concerned, and, in some instances, have been published in the Government Gazettes and in other local publications. Many of the reports made to the Government of India have been published in the Indian "Agricultural Ledger." Some of the more important reports have appeared in a condensed form in the "Bulletin of the Imperial Institute."

In addition to these the following reports have been issued in this country as Parliamentary Papers during 1906-7:—

Report on the work of the Imperial Institute during the year 1905. (Cd. 3116, 1906.)

Annual Report on the Indian Section of the Imperial Institute for the year 1905-06. (Cd. 3216, 1906.)

Annual Report on the Indian Section of the Imperial Institute for the year 1906-07. (Cd. 3679, 1907.)

Report on the Results of the Mineral Survey of Northern Nigeria, 1904-5. By Professor Dunstan. (Cd. 2875, 1906.)

Reports on the Results of the Mineral Survey of Southern Nigeria, 1903-4 and 1904-5. By Professor Dunstan. (Cd. 2876, 1906.)

Report on the Results of the Mineral Survey of Ceylon, 1904-05. By Professor Dunstan. (Cd. 3190, 1906.)

Report on the Results of the Mineral Survey of Ceylon, 1905-06. By Professor Dunstan. (Cd. 3762, 1907.)

At the York Meeting of the British Association, an address on "Some Imperial Aspects of Applied Chemistry" was delivered by Professor Dunstan, as President of the Section of Chemistry and Agricultural Science. This address included an account of the work of the Scientific and Technical Department of the Imperial Institute in its relation as a Central Department for intelligence and investigation to the work

of agricultural and other technical departments in India and the Colonies, and also considered the importance of the work which is being accomplished by this department to the manufacturing industries of this country. This address was re-printed in the "Bulletin of the Imperial Institute," Vol. IV., p. 310.

Certain investigations have furnished important scientific results which have been communicated to and published by the Royal Society, the Chemical Society, and other special societies. The following is a list of these publications:—

"The Present Position of the Chemistry of Rubber," by Mr. S. S. Pickles. (Reports of the British Association for the Advancement of Science, York Meeting, 1906.)

"Report on the Present Position of the Chemistry of Gums," by Mr. H. H. Robinson. (Reports of the British Association for the Advancement of Science, York Meeting, 1906.)

"The Chemical Aspects of Cyanogenesis in Plants," by Professor W. R. Dunstan and Dr. T. A. Henry. (Reports of the British Association for the Advancement of Science, York Meeting, 1906.)

"Cyanogenesis in Plants. Part IV. Occurrence of Phaseolunatin in Common Flax," by Professor W. R. Dunstan, Dr. T. A. Henry and Dr. S. J. M. Auld. (Proceedings of the Royal Society, 1906. 78 B. 145.)

"Cyanogenesis in Plants. Part V. Occurrence of Phaseolunatin in Cassava," by Professor W. R. Dunstan, Dr. T. A. Henry and Dr. S. J. M. Auld. (Proceedings of the Royal Society, 1906. 78 B. 152.)

"On the Occurrence of Prussic Acid and its Derivatives in Plants," by Dr. T. A. Henry. (Science Progress, 1906.)

"The Gum of *Cochlospermum Gossypium*," by Mr. H. H. Robinson. (Transactions of the Chemical Society, 1906.)

"Investigation of Tanning Materials," by Dr. T. A. Henry. (Year Book of the Manchester, Liverpool, and District Tanner's Federation, 1906, p. 79.)

"Geikielite and the Ferro-Magnesian Titanates," by Mr. T. Crook and Mr. B. M. Jones. (Mineralogical Magazine, 1906, 14, p. 160.)

"A New Method for the Estimation of Acetone," by Dr. S. J. M. Auld. (Journal of the Society of Chemical Industry, 1906, 25, 100.)

"The Rocks of the Cataracts of the Rio Madeira and the adjoining portions of the Beni and Mamose," by

Dr. J. W. Evans. (Quarterly Journal of the Geological Society, 1906, 62, p. 88.)

"The Identity of the Amiantos or Karystian Stone of the Ancients with Chrysotile," by Dr. J. W. Evans. Dr. J. W. Evans. (Science Progress, 1906.)

"Gnomonic Projections on two planes," by Dr. J. W. Evans. (Mineralogical Magazine, 1906, 14, p. 149.)

"Determination of the Optic Axial Angle of Biaxial Crystals in Parallel Polarized Light," by Dr. J. W. Evans. (Mineralogical Magazine, 1906, 14, p. 157.)

"The Quantitative Classification of Igneous Rocks," by Dr. J. W. Evans. (Science Progress, 1906.)

1907:—

"Cyanogenesis in Plants. Part VI. Phaseolunatin and the Allied Ferments in Flax, Cassava, and the 'Lima bean,'" by Professor W. R. Dunstan, Dr. T. A. Henry, and Dr. S. J. M. Auld. (Proceedings of the Royal Society, 1907. 79 B. 315.)

"Le glucoside cyanogenetique de *Phaseolus lunatus*," by Professor W. R. Dunstan and Dr. T. A. Henry. (Annales de Chimie et de Physique, 1907, 10, p. 118.)

"Le glucoside cyanogenetique de lin," by Professor W. R. Dunstan and Dr. T. A. Henry. (Bulletin de l'Academie Royale de Belgique, 1907, No. 7, p. 790.)

"Note on the Constituents of the Seeds of the Para rubber tree (*Hevea brasiliensis*)," by Professor W. R. Dunstan. (Proceedings of the Chemical Society, 1907, 23, 168.)

"The Rusting of Iron," by Professor W. R. Dunstan. (Proceedings of the Chemical Society, 1907, 23, 63.)

"Baddeleyite from Ceylon," by Mr. G. S. Blake and Dr. G. F. Herbert Smith. (Mineralogical Magazine, 1907, 14, 378.)

"Titaniferous Volcanic Rocks," by Mr. T. Crook. (Geological Magazine, 1907; April.)

"The Use of the Electro-Magnet in Petrography," by Mr. T. Crook. (Science Progress, 1907; July.)

"An Automatic Vacuum Regulator," by Mr. A. E. Andrews. (Chemical News, 1907; August 16, 96.)

"The Relationship between the Colour and Constitution of Organic Compounds," by Dr. S. J. M. Auld. (Science Progress, 1907; April.)

"Mercury Derivatives of Pseudo-Acids containing the group -CO-NH," by Dr. S. J. M. Auld. (Journal of the Chemical Society, 1907, 91, p. 1045.)

"The Hydrolysis of Amygdalin by Emulsin," by Dr. S. J. M. Auld. (Proceedings of the Chemical Society, 1907, 23, p. 72.)

"Ueber Mercuri-Nitrophenole," by Dr. A. Hantzsch and Dr. S. J. M. Auld. (Berichte, 1906, 39, 1105.)

"Notes on Skiodroms and Isogyres," by Dr. J. W. Evans. (Mineralogical Magazine, 1907, 14, 230.)

"A simple arrangement and notation of the thirty-two classes of symmetry based on the symmetry of zone-axes," by Dr. J. W. Evans. (Mineralogical Magazine, 1907, 14, 360.)

"How should 'faults' be named and classified," by Dr. J. W. Evans. (Economic Geology, 1907, 2, 803.)

The following papers communicated by their authors to scientific societies deal with the investigations made at the suggestion of, and with materials supplied by, the Imperial Institute:—

"Calmatambin: A new Glucoside," by Dr. F. L. Pyman. (Transactions of the Chemical Society, 1907, p. 1228.)

"An Indigo-Yielding Plant," by Mr. A. G. Perkin. (Journal of the Society of Chemical Industry, 1907, 26, 389.)

VII.—SCIENTIFIC AND TECHNICAL DEPARTMENT.

Each year, since it was fully established in 1896, the work of this department has increased. In 1907, the staff consisted of 28 members, all of whom were qualified by scientific and technical training to assist in the conduct of researches, and to supply scientific and technical information concerning the occurrence and production of economic products, their industrial uses and commercial value. The reference sample room has proved of great value in supplying information to manufacturers and others who have enquired about new sources of raw materials, and also to agricultural and other officials from the Colonies who have visited the Institute.

The investigations conducted in the department during 1906 and 1907, which are described in detail in the separate sections, relate either to problems of tropical agriculture connected with the improvement of the cultivation and preparation of vegetable products, or to their technical uses and commercial value. Included under this head are a number

of products which are new to commerce. A very large number of minerals have also been examined and their chemical composition ascertained as the first step towards determining their commercial value. When results of special scientific importance are obtained these are communicated to the Royal Society or to one of the other scientific societies. During 1906 and 1907 a considerable number of papers from members of the scientific staff have been published (*see* list on pages 19-21). The resources of many of the Colonies and Protectorates being little known, it is important, with a view to development, that an inventory or *catalogue raisonné* of their products should be prepared and a decision arrived at as to those materials which are likely to repay collection or cultivation. The department has devoted much attention to this work. So far as vegetable products are concerned, their collection in the particular countries has usually been undertaken by the Agricultural and Botanical Departments which exist in many of the Colonies and Protectorates. Through the officers of these departments selections have been made of the subjects of greater importance, and the necessary material collected and forwarded to the Imperial Institute for investigation. In many of the Colonies and Protectorates no geological officers exist, and in several of these arrangements have been made for specially qualified men to conduct surveys of selected areas, and to collect authentic specimens of minerals which are forwarded to the Imperial Institute for investigation and report. The officers thus engaged in tropical Colonies and Protectorates return to this country during the wet season of each year, and assist at the Imperial Institute in the examination of the collected minerals, resuming the work of exploration in the ensuing season.

During 1906 and 1907, mineral surveys under the general supervision of the Director of the Imperial Institute, were in operation in four countries. Preliminary surveys were also undertaken in British East Africa and Uganda.

It is obvious that the success of the work of the department largely depends on the fullness and accuracy of the information and material supplied from the Colonies and Protectorates, and it is a great advantage for members of the staff, whenever they can be spared, to proceed to the countries concerned to prosecute special investigations and arrange for the conduct of local enquiries and experiments and the supply of authentic material. Unfortunately, the staff of the department has not been sufficiently extensive, whilst its current work has been too great to enable this temporary detachment of its officers to take place except under very special circumstances.

In addition to the systematic survey of the resources of the newer Colonies and Protectorates which has been referred to, the department has received from more developed Colonies and from many of the self-governing Colonies, as well as

from India, enquiries for information and investigation connected with agricultural problems and the utilisation of raw materials, many of which were of a confidential character.

Enquiries from business firms and others interested in the utilisation of raw materials have been freely answered and samples and information supplied, but laboratory investigations for commercial firms and private individuals have not been undertaken except under special circumstances. Requests for ordinary analyses have been referred to competent professional analysts.

It will be evident that, in order effectively to discharge the duties of a department for the supply of information and advice on tropical agriculture and tropical products, it is necessary to be in constant touch with the developments which are taking place and with the progress which is being made not only in every British Possession, but also in foreign countries and their colonies and protectorates. The collection and collation of all published information on subjects within the scope of the work of the department, and correspondence with similar departments abroad, has been an important part of its operations. In the subject of cotton cultivation alone, this has been a large and important work which, as far as possible, has been extended to other economic products.

The staff of the department consists of a number of scientific and technical assistants who have been for some years engaged in the investigation of the value of various classes of economic products, and with the numerous agricultural, geological, botanical, and other problems connected with their production or cultivation. Under their supervision are a number of junior assistants who have already received a scientific training and special chemical qualifications at a university or at a technical college where they have taken the usual degree or diploma. These men now specialise so as to gain experience in the applications of science to the solution of the practical problems with which the department is mainly concerned.

Although the applied sciences of chemistry, botany, geology and mineralogy are represented, it has not been possible to provide among the permanent staff experts in every branch of applied science, and in any case, it is desirable to utilise as far as possible the facilities offered by existing scientific and technical institutions for assisting the work of the department.

A reciprocal arrangement has been made with the Royal Gardens, Kew, by which all purely botanical matters have been referred to Kew, whilst all questions connected with the composition, utilisation, and commercial value of vegetable products are referred from Kew to the Imperial Institute. Similarly, in relation to animal products and the identification of insects, the Natural History Department of the British Museum and the Biological Department of the Agricultural College at Wye have been consulted.

Special problems connected with the composition and value of the vegetable dyes have been referred to the dyeing department of the Yorkshire College, Leeds, whilst several technical investigations, suggested by the scientific work of the department in connection with the utilisation of tanning materials, have been carried out by the Herold's Institute for tanning at Bermondsey. Several special questions relating to the utilisation of fibres have been referred to the Bradford Technical College.

Similarly, in connection with special technical investigations, assistance has been rendered by a number of distinguished authorities, among whom may be mentioned Professor Unwin, F.R.S., Professor Dalby, and Mr. Herbert Stone (technical examination of timbers), Professor Church, F.R.S. (value of food grains and feeding stuffs), Mr. A. G. Perkin, F.R.S. (dyes), Dr. Lewkowitsch (oils), Dr. Gordon Parker, (tanning materials), Mr. F. V. Theobald, M.A. (economic entomology), Professor J. T. Cash, F.R.S., and Professor Cushny, F.R.S. (drugs), Sir Thomas Wardle (silk). These and other authorities have dealt with special problems arising out of the work of the department.

A large number of manufacturing firms, merchants, and brokers have also rendered much assistance in determining the commercial value of raw materials on the basis of the results of their examination in the department.

The department has, therefore, been in a position not only to determine the nature and composition of materials, but also to submit to the expert referees and manufacturers, &c., suggestions for the commercial utilisation of these materials to be subsequently verified by actual technical trial on the large scale. By this means a trustworthy basis has been obtained for determining their actual commercial value and possibilities.

The principal investigations conducted during the year are summarised below under the headings of the various economic products to which they relate.

During 1906, 297 requests for investigations were received from India, the Colonies and Protectorates, whilst 282 enquiries were completed and reports made. In 1907, 392 requests for investigations were received and 398 reports completed. These investigations were conducted in connection with subjects concerning the following countries:—Bahamas, Barbados, Bermuda, British Guiana, British Honduras, Canada, Cape Colony, Ceylon, Cyprus, Dominica, East Africa Protectorate, Falkland Islands, Fiji, Gambia, Gold Coast, Grenada, Hong Kong, India, Jamaica, Lagos, Mauritius, Natal, New Zealand, Northern Nigeria, Nyasaland, Orange River Colony, Queensland, Rhodesia, St. Helena, St. Vincent, Seychelles, Sierra Leone, Somaliland, South Australia, Southern Nigeria, Sudan, Straits Settlements and Federated Malay Straits, Tasmania, Transvaal, Trinidad, Turks Islands, Uganda, Virgin Islands, Western Australia, Zanzibar.

A detailed account follows of the various subjects which have claimed the chief attention of the department during the two years under review. Brief allusion may be made here to a few of the most important of these subjects in connection with the countries concerned.

The progress of cotton cultivation in all the British Possessions has been carefully watched and information has been obtained as to the work which is being carried on in other countries. Samples of cotton grown in each British Possession have been examined and valued, reports being made to the Governments of the countries concerned and information supplied with reference to the various problems of cotton cultivation. In the summer of 1907 the Director visited Asia Minor at the instance of the Colonial Office in order to report on agricultural developments in that country, with special reference to cotton cultivation and other matters of importance in connection with similar developments in British Possessions.

Close touch has been maintained with the work of the British Cotton Growing Association, which has placed at the disposal of the department the reports of their managers and superintendents in the Colonies and Protectorates.

Considerable attention has also been given to the production of other fibre-yielding plants. The recent scarcity of Indian jute has rendered it desirable to consider whether jute and similar "bast" fibres could not be produced in West Africa, and a systematic investigation of the native fibres of Sierra Leone has been undertaken in conjunction with the Government of the Colony, and in association with the users of this class of fibre at home. The results of trial shipments of these fibres have shown that fibre of value to the jute manufacturer in this country can be grown in West Africa, including fibre from species of Hibiscus, Honckenya and Triumfetta, and in this connection it may be mentioned that a specimen of *Triumfetta semitriloba* fibre from the Gold Coast was valued in London at £35 per ton, with finest Bengal jute at £35 to £40 per ton.

A number of investigations have been conducted at the instance of the Government of St. Helena in connection with the establishment in the island of a fibre-producing industry. The growth of *Phormium tenax* (New Zealand hemp) has been extended, and arrangements made for the extraction of the fibre, which is now being shipped to this country.

The production of rubber has now become a most important subject for many of the tropical Colonies and Protectorates, and the department has supplied a great deal of information on the subject, and has examined and reported on the quality of the rubber produced by native and cultivated trees. The native collection of rubber from wild vines and trees will continue for many years to afford a substantial return, and the value of native rubber may be enhanced by the introduction of improved methods of collection and preparation.

It is, however, clear that the control of the methods of rubber collection and preparation adopted by the natives in the vast territories of forest in which rubber trees and plants occur presents administrative difficulties, and involves an expenditure which, in most cases, stands in the way of the introduction of anything approaching to the efficient regulation of the native rubber industry. Systematic planting of the larger rubber trees (such as *Hevea brasiliensis*), after adequate trial on a small scale of the suitability of the climate and other conditions, affords the best chance of securing a regular supply of rubber of the highest quality, and the progress already achieved in Ceylon and the Federated Malay States is causing other countries to consider this question. The West African Colonies and Protectorates in particular, as well as other Colonies, have been in communication with the department, with reference to the cultivation and production of rubber.

In connection with the present extensive planting of the Para rubber tree (*Hevea brasiliensis*), the fact that the abundant seeds of this tree can be utilised as the source of a valuable oil may become a matter of commercial importance in the near future, when the seeds will be available in quantities far in excess of those required for planting. The investigations conducted in the department have proved that this oil, which resembles linseed oil, will probably command about the same price as the latter commodity, whilst the residue of the seeds from which the oil has been expressed may prove to be serviceable locally as a feeding stuff for cattle. It is, therefore, possible that a valuable subsidiary industry may arise in connection with rubber planting.

The great possibilities of West Africa for the production of tropical products has led to a large share of the attention of the department being given to these Colonies and Protectorates. Besides cotton, fibres and rubber, the timbers and oil seeds of Southern Nigeria have been the subject of investigation, and certain new seeds have been introduced to manufacturers as sources of useful oils, especially for the manufacture of soap, and trial shipments of several of these have been arranged for. The tanning industry of West Africa has also been made the subject of investigation, with a view to the improvement of the leather at present produced, especially of certain kinds now demanded by the British manufacturer. The production of cocoa is an industry of growing importance in West Africa, especially in Southern Nigeria and the Gold Coast. In the latter Colony the subject of the improvement of the quality of the cocoa at present produced has engaged much of the attention of the department. The main point has been the demonstration by trial shipments that cocoa of the quality required by the British manufacturer can be produced. This has now been successfully shown, and as a result Messrs. Cadbury Brothers, Limited, have sent a representative to the Gold Coast in order to report upon the methods by which

this firm could advantageously co-operate with the native producer. In Uganda also conditions appear to be favourable to the cultivation of cocoa.

The production of ginger is a minor industry of some importance in Sierra Leone. Improvements in the methods of cultivation and preparation of this product have been suggested by the department, with the result that trial consignments of ginger produced by the improved methods have realised prices considerably above the average hitherto attained by West African ginger.

The Superintendent of Agriculture for British West Africa (Mr. G. C. Dudgeon) has been placed in communication with the Institute and has his headquarters there during his stay in England. The series of valuable reports which he has made have materially assisted the work of developing the resources of West Africa. Officers from Northern Nigeria, East Africa and other Colonies have also been attached to the Imperial Institute for special work either in connection with investigations or the arrangement of collections.

The mineral surveys of Southern and Northern Nigeria have made very satisfactory progress, and have been the means of bringing to light a number of minerals which seem likely to be of commercial importance to these countries. Two reports on the results of these surveys were published in 1906 (*see* p. 18). In Northern Nigeria limestone has been discovered in an accessible area, whilst an investigation has been made of the salt springs, with a view to determining their suitability for the production of salt of good quality. Tinstone and monazite sand have also been found in new localities. The quality and abundance of the tin-stone deposits justifies the belief that Northern Nigeria will become an important tin-producing country, as soon as transport facilities have been provided.

In Ceylon the mineral survey has had the result of attracting commercial attention to the varied mineral wealth of the island, and to the discovery of several minerals of commercial importance. Reports on the results of this survey have been issued as Parliamentary Papers (*see Publications*, p. 18).

In Nyasaland, in the first year of the survey, occurrences of coal, graphite, limestone, ores of iron and tin, and corundum have been located. The circumstance that extensive deposits of iron ore of good quality occur in the Protectorate may be of considerable importance in the future.

Extensive deposits of peat occur in the Falkland Islands, of which little or no use is made. The results of an exhaustive investigation of samples of this peat in the department showed that it is of excellent quality and adapted for the manufacture of briquettes. In view of the demand for fuel in South America, especially for use in steamers and locomotives, a syndicate has been formed with a view to the instalment of a peat briquetting industry in the Falkland Islands.

Considerable attention has been given during the period under review to an investigation of the resources of the

Seychelles, and numerous reports have been made to the Government of that Colony. It has been shown that several barks of trees belonging chiefly to the mangrove class are particularly suitable for the preparation of tanning extracts, and the commercial side of this question is now under consideration. The examination of certain volatile oils produced by plants grown in the islands has shown that these are of a quality which renders them of considerable value as perfumes.

In Cyprus, also, the examination of the oils derived from origanum and marjoram, which are used for perfuming soap, has shown that the production of such oils will prove to be a remunerative industry. A considerable quantity of Cyprus origanum oil has now been sold in England, and suggestions have been made with a view to improvements being effected in its quality.

As a result of an examination of a series of samples of gum arabic collected in Northern Nigeria, the attention of the users of this product was directed to the suitability of Northern Nigeria gum, with the result that a demand has arisen leading to an increase in the amount of gum collected and exported to this country. In the summer of 1907 the Director, at the instance of the Colonial Office, collected information abroad respecting the organisation of the trade in Senegal and Sudanese gum at Trieste and elsewhere, and steps have been taken to develop the industry in Northern Nigeria.

In the case of the Straits Settlements and Federated Malay States, besides minerals, fibrous plants and rubbers, a number of essential oils and perfumes have been examined, and found to be of excellent quality. It seems probable that these may become the basis of a new industry.

Attention has also been given to the cultivation and preparation of tobacco in various Colonies. The conditions in Uganda and East Africa having been proved to be suitable, an expert selected by the Director of the Imperial Institute has been despatched by the Colonial Office to advise the local Governments on this subject and to start experimental work.

The investigations conducted for the Government of India form the subject of special reports issued as Parliamentary Papers (Cd. 3216, 1906, and Cd. 3679, 1907).

The Indian subjects dealt with have been very varied, among the more important being the examination and valuation of tanning materials, fibrous plants, the investigation of drugs and poisonous plants and of the quality of india-rubber.

A large number of manganese ores from different deposits in India were examined at the request of the Geological Survey of India. The results obtained will be of great value to those interested in the development of these important deposits. In connection with the attention which the Geological Survey of India is also giving to the possible utilisation of the deposits of bauxite which occur in India as sources of aluminium and

aluminous compounds, a number of typical Indian bauxites have been examined from the scientific and technical standpoint.

In connection with tropical agriculture an investigation of much practical importance to India, and to the Colonies, as well as of purely scientific interest, is that relating to the poisonous properties which are occasionally exhibited by certain food-grains and fodder plants. During the period under review further investigations on this subject have been completed, especially in connection with cassava and linseed, and the results of scientific interest communicated to the Royal Society (*see* list of papers on pp. 19-21). The poisonous action in most of the cases investigated is due to prussic acid, which is now shown to be formed from an occasional constituent of the plant, which has been very fully studied and the conditions of its production ascertained. The Board of Agricultu
well as several manufacturing firms, have been in comm
tion with the Imperial Institute on several practical que
of importance in connection with the use of certain animal-feeding materials which are imported from abroad for use in this country.

The scientific and technical work conducted for India at the Imperial Institute is carried on in communication with the Board of Scientific Advice appointed in India by the Government. This Board includes the heads of all the scientific and technical establishments in India. At the request of the Government of India the Royal Society acts in an advisory capacity in connection with this work, and has appointed a special Advisory Committee, of which the Director of the Imperial Institute is a member.

In India, as in the Colonies, the scientific and technical work of the Imperial Institute is directed towards supplementing and extending the work of the local scientific and technical departments (agricultural, botanical and mineral) by undertaking such investigations as cannot be conducted on the spot, and especially economic investigations which have to be supplemented by reference to manufacturers and commercial experts.

At the request of the Government of India the methods employed in the manufacture of opium alkaloids from waste opium at the opium factory at Ghazipur, have been studied and improved. A report on the improved processes suggested has been furnished, and the new plant required has since been despatched to India.

In addition to the work conducted for India and the Colonies, a number of materials produced in foreign countries have been examined at the instance of British Consuls abroad, on account of the probable interest of these products for the British manufacturer.

Several special investigations and enquiries have been undertaken for the Board of Trade, the Board of Agriculture, and the Foreign Office.

In the following account of the work carried on in the department during 1906 and 1907, the subjects are mentioned under the names of the various economic products to which the work has related. It will be seen that the work of the department is becoming of increasing importance to the Colonies, not only as a means of investigating and providing trustworthy reports as to the probable value of little-known materials, but also through the supply of information respecting the constantly changing requirements of manufacturers and users of well-known raw materials.

The reports of the Institute are generally made to the Colonial Governments, but there has been during the period a remarkable increase in the requests for information made to the Institute by manufacturers and users of raw materials both in this country and abroad.

SUMMARY OF INVESTIGATIONS.

MINERALS.

Minerals reported on during 1906.	No.	Minerals reported on during 1907.	No.	Minerals awaiting investigation at the end of 1907.	No.
Sierra Leone ...	22	Cyprus	1	Cyprus	5
*Southern Nigeria and Lagos.	34	Sierra Leone ...	4	*Southern Nigeria and Lagos.	328
Cape Colony ...	2	Gold Coast Colony	2	*Northern Nigeria	242
Orange River Colony.	3	*Southern Nigeria and Lagos.	8	Cape Colony ...	3
Transvaal... ...	1	*Northern Nigeria	771	*British East Africa.	26
Rhodesia	5	St. Helena ...	3	†Uganda ...	58
Nyasaland... ...	5	Cape Colony ...	6	Rhodesia... ...	4
Uganda	22	Natal	2	*Nyasaland ...	242
British East Africa	123	Orange River Colony.	7	India	97
Zanzibar	8	Rhodesia... ...	2	*Ceylon	48
Sudan	8	Nyasaland ...	7	Federated Malay States.	1
Seychelles... ...	2	Uganda	9	South Australia...	3
India	85	British East Africa.	3	Falkland Islands	6
*Ceylon	230	Seychelles ...	4		
Federated Malay States.	7	India	8		
South Australia ...	5	*Ceylon	235		
Western Australia	1	Federated Malay States.	11		
New Zealand ...	1	Tasmania ...	4		
Falkland Islands...	13	Queensland ...	1		
British Honduras	1	Fiji	1		
Trinidad	2	Falkland Islands	1		
Turks Islands ...	1	Virgin Islands ...	3		
Newfoundland ...	3	Dominica ...	1		
Foreign Countries	8	Trinidad... ...	2		
Miscellaneous ...	5	Canada	1		
		United Kingdom	18		
		Foreign Countries	25		
Total... ...	597	Total... ...	1140	Total... ...	1063

* Mainly collected by the officers of the mineral survey.

† Includes samples collected by the mineralogist attached to the Anglo Congolese Boundary Commission.

Sierra Leone.—The minerals received from this Colony were mainly sands supposed to contain rare earths. One or two of these proved to contain traces of monazite. Iron ore of fair quality has been reported on, as well as several sands consisting mainly of ilmenite and magnetic iron ore.

Gold Coast.—Specimens of mineral oil and bitumen were examined during 1907.

St. Helena.—Several specimens of the manganese ores found in this Island were examined during 1907. They proved to be of rather poor quality and unsuitable for use without preliminary dressing.

Cape Colony.—China clay of excellent quality, probably suitable for export, was examined in 1906. During 1907 manganese ores, crocidolite asbestos, china clay, chromite, and rocks containing traces of platinum were received for examination, and most of these were the subjects of reports to the Government during the year.

Natal.—The minerals received during 1907 included graphite and iron ore. The latter proved to be of good quality. The graphite is still under investigation.

Orange River Colony.—The minerals from this Colony, examined during 1907, included two of some general interest, viz., a crude salt containing 61 per cent. of true salt (sodium chloride) and a specimen of sodium sulphate. Both these products were obtained from natural salt springs.

Rhodesia.—Several minerals of economic interest were received in 1906, viz., antimony and chromium ores, a supposed gold ore, and marble, suitable for decorative stone work. In 1907 several other minerals were received for identification, and in addition a memorandum was prepared suggesting suitable manurial treatment for a series of soils on the basis of the results of analyses by the Agricultural Department at Buluwayo. At the end of 1907 soils, plumbago, clay, mica, and other minerals were still under investigation.

British East Africa.—During 1906 an extensive series of rocks collected during the course of the Anglo-German Boundary Commission in East Africa was received for identification. Soil from the neighbourhood of the Tana River was also examined.

Uganda.—Reference has been made above to the examination of minerals of interest collected during the progress of the Anglo-Congolese Boundary Commission.

In addition a number of minerals from this Protectorate have been received from the Government. In 1906 these included iron ore, limestone, graphite, and kaolin, and in 1907, specimens of water and brine from mineral springs, and an iron ore from the Masindi district. Iron is smelted by the natives in this district in a primitive fashion, and as transport

from the coast is difficult and expensive, it appears likely that the native iron smelting industry is worth encouragement, and at the request of the Government, a memorandum has been prepared describing a furnace of a simple type suitable for smelting iron, which can be operated by means of cold blast produced by water power.

Sudan. The minerals examined during 1906 included varieties of "natron" (consisting of sodium carbonate and sodium sulphate) and of graphitic schist, iron ore, and locally smelted iron.

Seychelles.—The composition and value of the phosphate deposits has been considered in consultation with users of these materials in this country.

During 1906 the mineral phosphates found in Alphonse and Marie Louise Islands were examined. These proved to be of excellent quality, containing from 64 to 67 per cent. of calcium phosphate with satisfactorily small amounts of impurities, such as iron and alumina, and were valued at 35s. to 40s. per ton. In 1907 specimens of the yellow laterites found in several of the islands were received: these proved to be of poor quality and unsuitable for the manufacture of aluminous products.

India.—During 1906 an extensive series of manganese ores collected by the Geological Survey of India were examined and reported on, and early in 1907 a supplementary report giving the results of complete analyses of a certain number of the ores was forwarded to India. These manganese ores are typical of those obtainable in the Central Provinces in India, and the results of these combined geological and chemical investigations should be of service not only to those interested in the development of these deposits in India, but also to steel manufacturers in this country and elsewhere. Information concerning these ores has been supplied to commercial firms in this country.

The Geological Survey of India has also been giving attention to the possibility of utilising the extensive deposits of bauxite (laterite), which occur in India, for the preparation of alumina and aluminous compounds and possibly for the manufacture of metallic aluminium. In connection with this enquiry six typical Indian bauxites were sent to the Imperial Institute for examination. The results showed that they were of promising character, and that although differing in certain respects from the typical bauxites now used in Europe as a source of aluminium and aluminous compounds, they did not present any insuperable difficulties for use as raw materials for such purposes.

A series of Indian pottery clays collected by the Officiating Reporter on Economic Products, in consultation with the Geological Survey of India, has also been received and is still under investigation.

Apart from the minerals referred to above, various minerals for valuation or identification have been received, partly from officers of provincial governments in India and partly from commercial firms and private individuals. Among samples so received may be mentioned, mica, gypsum, calcite, orpiment, samarskite, pitchblende, &c.

Federated Malay States.—In 1906 samples of corundum, monazite sand, "amang" (a local term for the residues from washing operations carried out in the preparation of tin ore for smelting), and "mineral tailings" were examined. The first three products proved to be of economic value, and as regards "amang," a method of recovering the tinstone and monazite from the mixture, was suggested. The separation of monazite from tinstone may in the future prove to be a profitable undertaking, enabling the valuable monazite to be separated and making it possible to smelt the tinstone.

In 1907 a series of tin ores and of limestone carrying tinstone were received for examination and reported on. At the end of 1907 further samples of "amang" were under investigation.

Western Australia.—Specimens of tantalite were received in 1906 and during the two years under review, information regarding the market for, and developments in the uses of, this ore has been supplied to the Government of the State.

Southern Australia.—The minerals received from this State for examination have included raw sienna, graphite, kaolin, and carnotite. The last-mentioned rare mineral is still under investigation.

Falkland Islands.—The peat from these islands has been fully examined and reported on during 1906 and 1907. The peat proved to be of good quality, and full information was supplied as to modern methods of making compressed peat fuel. As a result of this work a concession to work the deposits has been applied for by a syndicate, with a view to the production of compressed peat fuel for use in the islands and in the neighbouring South American States.

New Zealand.—A sample of the iron ore found at Parapara was received and examined. It proved to be a very rich ore, of great value for smelting purposes.

Trinidad.—Further samples of manjak were received for examination in 1906. In 1907 limestone and marl were received from the Colonial Geologist for examination and technical trial as cement-making materials. Cement made from these materials proved to be of good quality and quite suitable for constructional purposes.

Turks Island.—The salt produced in this Island, mainly for export to the United States, was received for examination.

This material is much in favour in the United States for salting provisions. The sample proved to be exceptionally pure.

Foreign Countries.—A considerable number of samples were received during the two years from British Consuls in foreign countries. None of the mineral samples so received proved to be of special economic interest.

Mineral Surveys.

The mineral surveys in Ceylon, Southern Nigeria and Northern Nigeria, referred to in the previous report, were continued during 1906, and a new survey was undertaken in the Nyasaland Protectorate. During 1907 arrangements were also made for the examination at the Imperial Institute of minerals collected by (1) the mineralogist appointed to accompany the Anglo-Congolese Boundary Commission, and (2) the Government mining expert appointed in British East Africa.

Ceylon.—1906.—Three reports were made during the year to the Government of Ceylon giving the results of the examination at the Imperial Institute of minerals forwarded from Ceylon in connection with the mineral survey, and these have since been published by the Colonial Office, together with the previous year's report, in Professor Dunstan's "Report on the Results of the Mineral Survey in 1904-05" (Cd. 3190 of 1906). The most interesting minerals described were zirkelite, tscheffkinite, monazite, fergusonite and pitchblende, all of which contain the valuable oxide thoria, which is the basis of the mantles used for incandescent gas lighting. None of these minerals is, however, so rich in thoria as the new mineral, thorianite, previously described, but they are all likely to be of commercial value as sources of thoria.

The same report gives the results of the examination of a very large number of gravels sent, with the approval of the Government of Ceylon, to the Imperial Institute by residents in Ceylon interested in mineral production. Most of these gravels consisted of zircon or ilmenite, and were of no commercial value, but a few contained minerals of economic interest, such as tinstone, allanite, monazite, thorite and thorianite, and where such minerals were present in sufficient quantity, those interested were placed in communication with manufacturers in this country, who wished to utilize such minerals.

1907.—Professor Dunstan's "Report on the Results of the Mineral Survey in 1905-06" was issued during the year in the Miscellaneous Series of Colonial Reports (Cd. 3762 of 1907). This gives the results of the examination of minerals collected during the course of the survey in 1905-06. The minerals received were mainly concentrates prepared in the course of a systematic investigation of stream beds and alluvial deposits in various districts for thorianite and other

rare minerals. This investigation has shown that thorite, thorianite, monazite and gold are widely distributed in Ceylon, but usually only in small quantities and somewhat irregularly. Further exploration in Ceylon will decide whether such gravels will repay working.

Other minerals of economic interest received and reported on were kaolin, galena, limestone, rutile and molybdenite. The speciments awaiting investigation at the end of 1907 were mainly clays, micas, and concentrates containing thorium minerals.

In addition, a large number of minerals, mainly for identification and valuation, were received from residents in Ceylon.

Southern Nigeria and Lagos.—1906.—The samples of natural pitch collected by the officers of the survey during their investigation of the bituminous sand deposits of Lagos were reported on. These proved to be mainly sands, containing from 10 to 20 per cent. of true bitumen. In most cases the material is unsuitable for paving purposes, as the siliceous matrix will not bind under pressure in the same manner as the European asphaltes (which have a limestone matrix) at present utilized.

1907.—A number of minerals of considerable economic importance were reported on during the year. These included lignite from Moroko, which proved to be similar to the deposits at Okpenam and Ibousa previously examined, and galena and zinc blende from the deposits at Amago-Omegga. The lignite deposits are likely to be of great importance in the Colony, as affording a supply of fuel, which will be suitable for steam-raising. At the end of 1907 there were still awaiting investigation a large number of samples of lignite collected at various points in the areas surveyed during the season 1906-07, and a number of concentrates prepared from river gravels in the same neighbourhoods.

Northern Nigeria.—During the two years 1906 and 1907 over 700 specimens of rocks, concentrates and massive minerals were received for examination, and most of them have now been reported on to the Government of the Colony, whilst summary reports on the progress and results of the survey are in preparation.

The concentrates were essentially of three types (1) containing tinstone, (2) containing monazite, and (3) containing magnetic iron oxide intermixed with more or less ilmenite. These were collected over a very considerable area of the Protectorate, and the results of their examination have thrown much light on the distribution of these various minerals. Tinstone is already being worked in the Bauchi district of the Protectorate, and arrangements have been made for smelting the metal locally. As regards monazite it appears that although this mineral is widely distributed the deposits, so

far known, are not rich enough to be worth working by the methods at present available and at the prices now obtainable.

Deposits of limonitic iron ore of excellent quality were located during 1906. These are situated near navigable rivers and may be of value for export purposes if the deposits prove to be sufficiently extensive. These deposits are being used at present to a small extent by the natives for smelting iron for local use.

Among the more important economic work conducted by the survey, was the investigation of the brine springs at Awe, which appear to have been used in a primitive and uneconomical fashion since early times by the natives as a source of salt. Systematic borings have been made in this neighbourhood, in order to obtain knowledge of the sources of the salt. These investigations are still in progress. It has been already found that the outflow of brine can be enormously increased. This brine on evaporation yields salt of excellent quality. The brine is unfortunately rather weak, and its economical evaporation is a problem of some difficulty, but in view of the low price of labour in the Protectorate and the fact that there is a long dry season during which evaporation by solar heat can be carried on to great advantage, it seems likely that this could be cheaply effected. A preliminary scheme involving the employment of "salins" of the type used in France and Spain has been suggested for use in the Protectorate, and as the price of salt at Awe varies from £12 to £26 per ton, depending on its quality, it seems likely that this industry, if properly organised, and carried out on modern lines, should be remunerative. The district in which the brine springs occur is not far from navigable rivers, so that it ought to be possible to distribute the salt cheaply throughout a considerable part of the Protectorate, and render unnecessary the considerable import of European salt which takes place at present.

Nyasaland.—This survey was commenced in September, 1906. Since then a large number of rocks and minerals have been received for examination, and at the end of 1907 a report on those collected during the season 1906-07 was in preparation. These included corundum, iron ores, coal, shale and graphite. The graphite may be of some importance. The samples consisted of flake graphite of excellent quality.

At the end of 1907 there remained under investigation a number of minerals of which the most important were coal from two deposits which have been thoroughly explored by the officers of the survey.

A considerable number of minerals forwarded by Political officers have also been reported on. These include limestones, iron ores, and quartz crystals, all of which are of commercial interest.

Anglo-Congolese Survey Commission.—The mineralogist nominated by the Director of the Imperial Institute to accompany this Commission during the work of delimiting the frontier between Uganda and the Congo Free State has examined the geological structure of the country along the boundary, and has sent to the Imperial Institute periodical reports on the structure of the country traversed. The rocks and minerals collected are at present under investigation.

British East Africa. The mining expert, recently appointed by the Government of the Protectorate to deal with mining claims and mineral rights, is working in communication with the Imperial Institute with a view to ascertaining the nature and value of minerals found in the Protectorate. A number of minerals have been received and are at present under investigation.

FIBRES (INCLUDING COTTON).

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Cyprus	1	Cyprus	2	Cyprus	1
Sudan	5	Sudan	10	British East Africa.	2
British East Africa	33	British East Africa.	10	Sierra Leone ...	1
Uganda	2	Nyasaland Protectorate.	43	Southern Nigeria	1
Rhodesia	5	Uganda	11	Northern Nigeria	4
Transvaal... ...	40	Rhodesia... ...	4	India	1
Gambia	1	Natal	22	Foreign countries	31
Gold Coast ...	2	Transvaal ...	45		
Sierra Leone ...	17	Orange River Colony.	4		
Southern Nigeria...	8	Cape Colony ...	3		
St. Helena ...	2	Gambia	7		
India	5	Gold Coast ...	18		
Straits Settlements and Federated Malay States.	2	Sierra Leone ...	6		
West Indies ...	17	Southern Nigeria	54		
British Honduras	1	Northern Nigeria	33		
Australia	1	Mauritius ...	13		
Foreign countries	15	St. Helena ...	2		
Unknown sources	4	India	27		
		Ceylon	2		
		Straits Settlements and Federated Malay States.	1		
		West Indies ...	1		
		British Guiana ...	18		
		Australia ...	2		
		United Kingdom	1		
		Foreign countries	14		
		Unknown sources	2		
Total... ...	161	Total... ...	365	Total... ...	41

Cotton.

The number of cottons reported on in 1906 was 71, and in 1907 256. At the end of 1907, 31 samples were awaiting investigation.

In addition to the 327 samples reported on in 1906-07, 104 samples were examined and added to the reference collection, which now amounts to nearly 1,000 samples of cotton and cotton-plant specimens. A collection of standard commercial cottons, comprising about 60 samples, has also been formed.

The reports on cottons included a technical examination of the cotton and valuations by commercial experts. Insect pests were frequently found in the samples: in most cases these were identified and suggestions for remedial measures were incorporated in the report. The insect pests were labelled and preserved for future reference.

Much agricultural information has been given in reply to enquiries with reference to soil, manures and the treatment of insect and fungoid pests in their relation to cotton cultivation. A number of articles on cotton cultivation have been contributed to the "Bulletin of the Imperial Institute," and all available information appertaining to the progress of cotton cultivation in the various British Colonies and Dependencies has been collected and arranged for reference.

Cotton has been received for examination from the following countries:—Sudan, British East Africa, Uganda, Nyasaland, the Transvaal, Orange River Colony, Natal, Cape Colony, Gambia, Sierra Leone, Gold Coast Colony, Southern Nigeria, Northern Nigeria, India, Ceylon, Mauritius, St. Helena, Federated Malay States, Grenada, Barbados, St. Vincent, Trinidad, British Guiana, British Honduras, Mozambique, Java, and New Caledonia.

The results of the examination of cotton are briefly summarised in the following paragraphs:—

1906.

Sudan.—Two samples, one ginned and the other unginned, from the Bahr-el-Ghazal were similar to Peruvian cotton, but contained a quantity of short fibre.

East Africa Protectorate.—Thirteen samples were examined, comprising nine Egyptian, two American and two Sea Island varieties. The Egyptian cottons were valued at 2½*d.* to 3½*d.* per pound less than "fully good fair" Brown Egyptian, the American at 50 points less than "middling American," and the Sea Island at 1½*d.* to 3½*d.* per pound less than "fancy" Florida Sea Island. The Egyptian varieties were probably the most promising. In many of the samples there were insect pests of *Oxycarenus sp.*, and some small grubs were found alive in the seeds.

Uganda.—A sample of Egyptian cotton grown at Entebbe was examined. It was of the "Abassi" type, but rather rough, and worth 7½*d.* to 7¾*d.* per pound when "good" Abassi was quoted at 9½*d.* per pound.

Transvaal.—Twenty-seven samples of cotton grown in the Zoutpansberg district were examined. Twenty-one were of improved American Upland type, four were Egyptian and the remaining two Sea Island varieties. The American Upland cottons were the most satisfactory; they were generally of excellent quality, and were valued at from 5·75*d.* to 8·25*d.* per pound, with "middling" American at 6·08*d.* per pound. The Egyptian cottons were of the "Mitafifi" type, of promising quality, and worth from 7¾*d.* to 8¼*d.* per pound, "good" Brown Egyptian at 8½*d.* per pound. The Sea Island variety was of fairly good quality, and was regarded as worth 9*d.* per pound, with "fancy" Georgia Sea Island at 10½*d.* per pound.

Four samples were examined which had been grown in Swaziland; they were stated to consist of the residue left on the bushes after the first picking. All the samples were of useful quality.

British West Africa. Thirty-one samples were received; one from Southern Nigeria (Lagos) was examined and valued, whilst one from the Gambia, and twenty-nine from the Gold Coast were added to the reference collection.

The cotton from Southern Nigeria was of the Sea Island variety; it was of promising quality and worth 10*d.* to 11*d.* per pound, with "fancy" Florida Sea Island at 13*d.* per pound.

India.—A sample of unginned cotton grown in the Singbhum district of Bengal was short and harsh, but of satisfactory quality. It was valued at 3¾*d.* per pound, with "fine" Bengal at 4¼*d.* per pound.

Grenada.—Two samples of ginned cotton grown in Carriacou were examined. One was of "Sea Island" character, of good quality and worth 10*d.* to 10½*d.* per pound, with "fancy" Florida Sea Island at 13*d.* per pound. The second sample, consisting of "Marie Galante" cotton, was of Peruvian type and was valued at 7*d.* to 7½*d.* per pound, with "good" moderately rough Peruvian at 7¾*d.* per pound.

Barbados.—Six samples were added to the reference collection.

St. Vincent.—Fourteen samples of ginned Sea Island cotton were examined and found, in the majority of cases, to be of excellent quality, highly lustrous and uniform in colour. It was pointed out that some of the samples had been stained by oil from crushed seeds, and it was recommended that the gins should be more carefully adjusted.

British Honduras.—A sample of unginned Sea Island cotton grown at the Corozal station, was examined. It was found to

be stained, immature, and greatly deteriorated, and nominally worth about 8*d.* per pound, with "fancy" Florida Sea Island at 12*d.* per pound. It was suggested that better results might perhaps be obtained by the cultivation of American Upland or Egyptian cottons.

Mozambique.—Three samples of ginned cotton were examined; two were probably native varieties, but were not unlike Egyptian cotton. The third sample, a brown Egyptian variety, was the most satisfactory; it was very clean, soft and of good colour. The first two were sold at 6*d.* and 7¾*d.* per pound, and the third at 9*d.* per pound, with "fully good fair" brown Egyptian at 9 5/16*d.* per pound.

Java.—Two samples of ginned brown Egyptian cotton were examined and found to be of good useful quality, but not equal to a standard sample of brown Egyptian cotton with which they were compared.

1907.

Sudan. Two samples of ginned and eight samples of unginned cotton were examined. They comprised American Upland, Sea Island, Egyptian, Caravonica and native varieties. The American cottons were of very good quality and were valued at prices higher than those current for "middling" American cotton. The other specimens, although not equal in value to standard samples, were of promising quality, and would be readily saleable.

Uganda.—Two samples of Caravonica cotton of the so-called "silk" variety, and one sample of "Black Rattler" American cotton were examined. The Caravonica cotton was of very good quality, similar to Egyptian Abassi, and was valued at 9½*d.* to 10*d.* per pound, with "good" Abassi at 14½*d.* per pound. The American cotton which had been grown in the Chiole district, though rather harsh and woolly, was worth about ½*d.* per pound more than "middling" American cotton.

Nyasaland.—Thirty-nine samples of cotton, twenty-two ginned and seventeen unginned, which were examined, included American Upland, Sea Island, Egyptian and native varieties. There was a great variation in the quality of the material, the same variety of cotton grown on different estates showing widely different qualities. Many of the samples were stained and showed signs of the attack of insect pests. It was considered that on the whole the cottons were of very promising quality, and that with greater care in cultivation and the adoption of preventive measures against the attacks of insect pests, it would be possible to grow very good, marketable cotton, both American and Egyptian, in Nyasaland. Three additional samples were added to the reference collection.

Transvaal.—Forty-three samples of cotton were examined; fifteen were stated to have been badly picked, fifteen were

"ratooned" cottons, and the remaining thirteen samples had been picked from the plants of the first year, grown on land which had been twice irrigated. The varieties included American, Sea Island, Egyptian and Indian. The American cottons were the most promising and were valued at 5*d.* to 7·75*d.* per pound, with "middling" American at 5·66*d.* per pound. The other specimens were fairly satisfactory, but not equal to standard samples of the corresponding varieties.

Orange River Colony.—A sample of unginned cotton grown from improved American seed was examined. It was of very good quality but slightly immature, and was valued at 5¾*d.* to 6½*d.* per pound, with "middling" American at 6·18*d.* per pound.

Natal.—Twenty-eight samples of ginned cotton were received from Natal, comprising American, Sea Island, Egyptian and "kidney" varieties. The improved American cottons were the most satisfactory, being valued at from 5½*d.* to 11*d.* per pound, with "middling" American at 7·40*d.* per pound. As many of the samples contained stained and immature cotton, the adoption of improved methods of cultivation and harvesting, as well as preventive measures against the ravages of insect pests, were especially recommended.

Cape Colony.—Two samples of cotton were received for examination. One, which had been grown in Griqualand West, was found to be a mixture of Sea Island and brown Egyptian cotton; it was of fair quality and was valued at about 9½*d.* per pound, with "fully good fair" brown Egyptian at 10 5/16*d.* per pound. The advisability of keeping the different varieties distinct was specially pointed out. The second sample, which had been grown at Port Elizabeth, consisted of Sea Island cotton of promising quality, and was valued at 12*d.* per pound, with "fancy" Florida Sea Island at 18¼*d.* per pound.

British West Africa.—Seventy-six samples were examined, of which one was grown in the Gambia, two in Sierra Leone, thirteen in the Gold Coast, thirty-one in Southern Nigeria and twenty-nine in Northern Nigeria, as follows:—

Gambia.—A sample of unginned native cotton which was examined was found to be of fairly good quality and somewhat similar to American cotton. It contained a quantity of stained fibre and was valued at 7*d.* per pound, with "middling" American at 7·40*d.* per pound.

Sierra Leone.—Two samples of unginned "Quondi" cotton were found to be of good quality and similar to Indian cotton. They were valued at 5⅞*d.* and 5¾*d.* per pound, with "good" Broach at 5⅞*d.* per pound.

Gold Coast.—Thirteen samples of unginned cotton received from the Gold Coast, comprised American, native and hybrid varieties. The cotton was of very good quality, certain

samples being valued at 6½*d.* to 7½*d.* per pound, with "middling" American at 6·6*d.* per pound.

Southern Nigeria.—Eight samples of ginned cotton, grown on the Moor Plantation, Lagos, were examined. They consisted of native and hybrid varieties of good quality and of a little higher commercial value than "middling" American cotton.

Sixteen samples of ginned cotton from the Government Plantation at Oloke-Meji had apparently been grown from American seed, with the exception of one native or "khaki" cotton. The American varieties were of very good quality and were valued at from 6⅝*d.* to 7½*d.* per pound, when "middling" American was quoted at 6·64*d.* per pound.

Seven samples, consisting of American, native and hybrid varieties were examined and found to be of good marketable quality.

Eighteen additional samples were added to the reference collection.

Northern Nigeria.—The twenty-nine samples of cotton examined had been grown in various provinces. They comprised American, Egyptian, Brazilian and native varieties. The cotton was generally of promising quality, although some of the samples were much stained. The American cottons were valued at from 5½*d.* to 7½*d.* per pound, with "middling" American at 6·39*d.* per pound. The native varieties were also of good value, but the Egyptian and Brazilian cottons were of poor quality and not likely to repay cultivation.

One additional sample was added to the reference collection.

India.—A sample of long-stapled cotton grown at Deesa, Bombay, was examined. The cotton was rather rough but of good quality and somewhat similar to an American Upland cotton.

A sample from the Singbhum district of Bengal was of very satisfactory quality and worth about 6*d.* per pound, with "fine" machine-ginned Broach at $5\frac{9}{16}d.$ per pound.

Six samples of long-stapled cotton from Burma and Bengal were examined and found to be of promising quality and about equal in value to "middling" American cotton.

Three samples of Caravonica cotton from Madras were of excellent quality and were valued at from 12*d.* to 14*d.* per pound, with "good" Abassi at 14⅞*d.* per pound.

Seven samples of cotton from Poona, Bombay, were examined and found to be of poor quality; they were valued at from 3*d.* to 4½*d.* per pound, with "middling" American at 7·16*d.* per pound.

Forty additional samples of cotton, sixteen samples of cotton-soil, and a large number of herbarium specimens were added to the reference collection.

Burma.—Two samples were added to the reference collection.

Ceylon.—Three samples were added to the reference collection.

Mauritius.—Twelve samples of unginned cotton were examined; of these, two were of the Sea Island variety, three were Egyptian Mitafifi, and seven were American Upland cottons. The samples were of fair quality, but in some cases appeared to have been grown from mixed seed, and were consequently of low commercial value.

St. Helena.—One sample was added to the reference collection.

Federated Malay States.—A sample of cotton, stated to be an Egyptian variety, was examined and found to be harsh but of good colour and length. It approached a Peruvian type in character, and was valued at 8*d.* per pound, with "good" moderately rough Peruvian at 8·35*d.* per pound.

Trinidad.—A sample of improved American "Sunflower" cotton was soft and silky and of very good quality. It was valued at 10*d.* per pound, when "middling" American was quoted at 7·18*d.* per pound.

British Guiana.—Eighteen samples of ginned cotton of different varieties were examined. They comprised American, Sea Island, Egyptian, Peruvian, Caravonica and native cottons. These samples were of very promising quality and were valued at prices generally equal to, if not higher than, those of standard samples of similar varieties with which they were compared.

Mozambique.—Two samples of ginned cotton of brown Egyptian variety were found to be of fairly good quality but uneven in colour, and worth, respectively, 6*d.* and 6½*d.* per pound, when "fully good fair" brown Egyptian cotton was $10\frac{5}{16}$*d.* per pound.

New Caledonia.—Two very small samples of ginned cotton were examined; one was stated to be a native variety and the other American Upland. The samples appeared to be of promising quality, but they were too small for valuation.

At the end of the year, 30 samples of cotton from Asia Minor and one sample from Turkey remained under investigation.

Jute and Similar Fibres.

1906.—In continuation of the endeavours which are being made to establish a fibre industry in Sierra Leone, specimens of the fibres of *Hibiscus quinquelobus*, *H. lasiocarpus*, *H. esculentus* and *Honckenya ficifolia* were examined, together with a sample of a fibre termed "Borfroko," the botanical identity of which is at present unknown. The fibre of

Hibiscus quinquelobus ("Kowe" or "Corwey" fibre) has received particular attention in Sierra Leone owing to the facility with which it can be prepared. The sample examined was of good quality and resembled jute in its chemical composition and behaviour. The specimen of *H. esculentus*, although of promising character, was weak and of inferior length. This sample had been collected after the second series of fruits had been gathered. It was suggested that samples should be collected at different ages and submitted for examination in order that the best period for the extraction of the fibre could be ascertained, and this is being done. *Honckenya ficifolia* ("Napunti") grows abundantly in the swamps of the Sierra Leone Protectorate, and would yield a constant supply of fibre if care was taken in cutting it. It has been stated, however, that considerable difficulty is experienced in extracting the fibre, especially in the case of the older plants, and it has therefore been recommended that experiments should be carried out with the object of determining whether the fibre can be more successfully prepared from young plants. A sample of *Honckenya ficifolia* fibre was also received from the Gold Coast, but had been imperfectly cleaned, and was consequently of little value.

All these fibres, after examination, have been referred to manufacturers and commercial experts, and recommendations made to the authorities in the Colony as to further action.

Fibres of the jute class from the Sudan, Gambia and Mexico were also examined and reported on.

1907.—One of the most important fibre investigations carried out during 1907 was in connection with the Nyasaland fibres, known locally as "Denji" and "Nzonogwe," derived from *Sida rhombifolia* and *Triumfetta rhomboidea*, respectively. The fibres were found to be of useful quality. Three bales of the material which were forwarded for technical trials were submitted to a firm of spinners, who found that the fibres could be spun into very fair yarns, which could be utilised for the manufacture of bagging. The fibres were considered to be about equal in value to the medium grades of jute.

A consignment of about 1½ tons of "Kowe" (*Hibiscus quinquelobus*) fibre was received from Sierra Leone. The product was too coarse and harsh to be employed as a jute substitute, but realised £18 in the London market, for use in rope manufacture. A sample of "Napunti" (*Honckenya ficifolia*) fibre also forwarded from Sierra Leone, consisted of coarse, brown, bast ribbons, and it was stated that this represented the only form in which the natives could prepare the fibre. The material was only suitable for use as a paper material, and its collection and exportation for this purpose would probably be unremunerative.

A specimen of *Triumfetta semitriloba* fibre of excellent quality was received from the Gold Coast, and was valued at £35 per ton (with finest Bengal jute at £35 to £40).

Samples of jute were forwarded from the Gambia and from Northern and Southern Nigeria and furnished conclusive evidence that jute of excellent quality can be grown in West Africa if other conditions are favourable to the industry. The two samples from the Gambia were valued at £21 and £28, whilst the Northern Nigeria specimens were valued at £22 and £24 per ton. The samples from Southern Nigeria were very weak and in a matted and tangled condition, and worth not more than a few pounds per ton for use as tow. This bad result was probably due to over-retting.

Other jute-like fibres included those of *Hibiscus tiliaceus*, *H. quinquelobus*, *H. rostellatus* and *Urena lobata* from the Gambia, *Hibiscus esculentus* and *H. lunariifolius* from Southern Nigeria, *H. cannabinus* from Uganda, *H. radiatus* from Brazil, and *Hibiscus* sp. and *Urena* sp. from India.

A sample of jute from Southern Nigeria was under investigation at the close of the year.

Plantain and Banana Fibres (*Musa* spp.).

1906.—Fibres of *Musa* spp. were examined from Southern Nigeria, British East Africa, the Straits Settlements and Abyssinia. The samples from Southern Nigeria and the Straits Settlements had not been well prepared, but were of promising quality. The fibre of *Musa malaccensis* from the latter country was regarded as a useful fibre, and if carefully prepared and of good strength would be worth £41-£42 per ton. Four samples of wild banana fibre from British East Africa were of good quality and value, two of them being considered worth £45 to £46 and £48 to £50 per ton, respectively. These products were comparable with the best grades of Manila hemp, and would be readily saleable for rope making.

1907.—Specimens of plantain and banana fibres from the Gold Coast were of good quality but rather weaker than Manila hemp, and were valued at £40 and £36 per ton, respectively. A sample of native fibre from Rhodesia, evidently derived from *Musa* sp., was short and rather lacking in lustre, but if improved in these respects would probably be able to compete with fair or good Manila hemp at about £41 per ton. Samples of less value were received for examination from Lagos and Ceylon.

"*Aloe*" *Fibres* (*Agave, Sansevieria and Furcræa*).

1906.—Among the fibres of this class, attention was principally directed to the "bowstring" hemps (*Sansevieria* spp.), samples of which were received for examination from British East Africa, Sierra Leone, Lagos and the Sudan. Attempts have been made during the last two or three years

to develop a fibre industry in British East Africa, an account of which has been given in the "Bulletin of the Imperial Institute." (1907, V, 24.) The fibre which is being produced in the greatest quantity is that of *S. Ehrenbergii*. Specimens of this fibre which were examined showed that the product was of a useful character, and worth £24 to £28 per ton. This fibre shows a marked variation in the diameter of the strands or filaments, the fibre from the interior of the leaf being fine whilst that from the more external parts is very coarse. A sample of *S. Volkensii* was valued at £28 per ton, and was regarded as readily saleable. Samples of *S. guineensis* were valued at about the same prices as those of S. *Ehrenbergii*, but would have been worth a good deal more if they had been more carefully prepared.

Some excellent specimens of *S. guineensis* fibre were received from Sierra Leone, and were valued at from £28 to £40 per ton. Two small specimens of the fibre of the same plant were forwarded from Lagos, but were badly prepared and of uneven length. It was evident, however, that by careful preparation a product of useful quality could be obtained. Two samples of *S. guineensis* fibre from the Sudan were imperfectly prepared, but were sufficient to indicate that with greater care a good fibre could be obtained.

Other fibres of this class included specimens of Sisal hemp from Sierra Leone, Furcræa fibre from Sierra Leone, Southern Rhodesia and St. Helena, and Dracæna fibre from Sierra Leone and the Gold Coast.

1907.—A specimen of *Sansevieria guineensis* fibre from Sierra Leone was found to be well cleaned, of good colour and worth £31 per ton. Samples of the fibre of *S. Ehrenbergii*, *S. sulcata*, *S. Stuckyi*, and of an unknown species from British East Africa were examined, that of *S. sulcata* being valued at £25 to £30 per ton. Sansevieria fibres were also received from Rhodesia and Uganda.

Samples of *Furcræa gigantea* fibre (Mauritius hemp) were received from India, Natal, British East Africa, Uganda and St. Helena. The specimen from India was of somewhat uneven length and colour and was valued at £27 to £28 per ton, whilst that from Natal was of good colour but rather weak. The East African and Uganda samples were incompletely prepared, and worth £22 to £23, and £25 to £25 10*s*. per ton, respectively. The specimen from St. Helena was of unusual length (average six feet), and was worth £25 to £27 per ton, but would have been more valuable if better cleaned.

A specimen of *Agave rigida* fibre (sisal hemp) from India was of excellent length and colour and of fair strength, and was regarded as worth about £36 to £38 per ton. A sample of this fibre from British East Africa was valued at the current price of Mexican sisal (£34 to £35 per ton). A specimen of the fibre of *Agave americana* from India was of pro-

mising quality but somewhat imperfectly cleaned, and was valued at £27 to £28 per ton.

At the end of the year, a sample of Sansevieria fibre from Sierra Leone remained under investigation.

New Zealand Hemp (Phormium tenax).

1906.—A sample of *Phormium tenax* fibre from St. Helena was examined and found to be of good length and colour and of fair strength. The product had been somewhat injured in the process of preparation, some of the strands having been crushed and weakened, but otherwise was of excellent quality and readily saleable.

1907.—Phormium fibre from St. Helena was further examined in connection with the question as to the creation of a local "flax" industry. The specimen had not been very well cleaned, and was about equal to "fair" New Zealand hemp, and worth about £32 to £33 per ton. Circumstances being apparently favourable to the establishment of such an industry, it was recommended that an expert from New Zealand should be asked to proceed to St. Helena and advise as to the steps which should be taken.

Samples were also received for examination from Ireland and Buenos Ayres. An article on "New Zealand Hemp" was published in the "Bulletin of the Imperial Institute." (1907, V, 36.)

Paper-making Fibres.

1906.—A consignment of the sheathing leaves of *Musa textilis* from India was examined and found to be suitable for paper making locally, but probably not of sufficient value to export for the purpose. Other products examined were the leaves of *Hypoxis rigidula* and the stem of *Vellozia retinervis* from the Transvaal, and the fibre of *Broussonetia papyrifera* from Turkey.

1907.—Specimens of a native grass and palm leaf from North-Western Rhodesia, of a bulrush and "palmiet" plant from Cape Colony, and of "Napunti" bark from Sierra Leone were examined with the object of ascertaining their value for paper making. It is doubtful whether any of these materials could form the basis of a remunerative paper-making industry, under present conditions.

Flosses or Silk-Cottons.

1906.—Samples of "kapok," the seed-hairs of *Eriodendron anfractuosum*, were received from Madras, Lagos and Madagascar. The Indian product was of good quality, but contained a good deal of seed. It was regarded as worth 4½*d.* a pound, but if free from seed would have been worth 6½*d.*

per pound. The specimen from Lagos was inferior in colour to ordinary commercial "kapok," whilst the Madagascar sample was equal to a standard specimen from Java. A specimen of a silk-cotton (probably derived from *Bombax buonopozense*) from Uganda was equal in quality to a standard sample of "kapok." Among other specimens examined may be mentioned the floss of *Funtumia elastica* from West Africa. This product, however, is of little value, and is regarded as nominally worth about 1*d.* per pound.

1907.—A specimen of "kapok" from Mauritius was of inferior colour and lustre, and was valued at 4½*d.* to 5*d.* per pound. Other flosses examined included those of *Bombax malabaricum* from Burma and *Calotropis* spp. from India and from Fernando Po.

Ramie Fibre (Boehmeria nivea).

1906.—Specimens of ramie were received for examination from Cyprus, North-Eastern Rhodesia, East Africa Protectorate and Argentina. The Cyprus sample consisted of ribbons of unprepared bark, nominally worth about £10 per ton. The samples from Rhodesia were of promising quality, but were not suitably prepared for the market. Those from the East Africa Protectorate consisted of six specimens of filasse prepared by different processes and were examined particularly with reference to their relative strength.

In view of the uncertain market for this material it has been recommended that cultivation should be undertaken with caution.

1907.—Specimens of ramie were examined from Natal, Mozambique and Buenos Ayres. The Natal product consisted of ribbons of bark; it was of good quality, but was not in the condition in which ramie is usually met with in the market. A sample from British East Africa was under investigation at the end of the year.

Flax.

1906.—A sample of flax straw from the Transvaal was examined and found to be short, much branched and of no value as a source of flax fibre. Several samples from Broussa, Turkey, were also examined.

1907.—Samples were received from the Orange River Colony, East Africa Protectorate, Cyprus and Bengal. The sample from the Orange River Colony had been over-retted. It was of poor quality and was regarded as of no commercial value. The East African flax had also been over-retted, but was stated to be quite saleable as "codilla," and worth about £26 per ton. The samples received from Cyprus had not been perfectly prepared. The product was therefore regarded as worth only about £10 per ton The Bengal flax had not

been retted, but it appeared to be of very promising quality and likely to repay cultivation.

A further sample from Cyprus was under investigation at the close of the year.

Silk.

1906.—A sample of silk waste from Broussa, Turkey, was found to consist of the inner portions of cocoons; it was found that the material would be suitable for the manufucture of "spun silk."

1907.—Samples of silk from Uganda, the Transvaal and Ceylon, were reported on.

Several samples of a new variety of silk received from Uganda consisted of nests or colonies of cocoons formed by silk-worms of *Anaphe* sp. The material obtained from the cocoons and from their silky coverings was found to be suitable for the manufacture of spun silk. The cocoons were too small and too loosely constructed to be suitable for reeling.

Two samples of cocoons spun by the true silk-worm, *Bombyx* spp., from the Transvaal were of very promising quality, and were regarded as being worth 3*s.* to 3*s.* 6*d.* per pound.

A sample of Tussur silk cocoons probably spun by the silk-worm, *Attacus ricini*, were received from Ceylon. The silk was of good quality and worth about 1*s.* per pound.

At the end of 1907, samples of a new variety of silk of *Anaphe* sp. from Northern and Southern Nigeria were under examination.

Wool.

1906.—Three samples of wool "tops" were received from the Bradford Technical College and were reported on with special reference to their comparative strengths.

Five samples of "greasy" wool from British East Africa were found to be somewhat inferior in quality and to contain a large amount of "kemps" or dead hairs.

Miscellaneous Fibres.

1906.—A number of fibrous products were received for examination from the Transvaal, including the bulb of *Buphane disticha* (the "gift bol"), the leaves of *Sansevieria ethiopica*, which contain a fine but rather short fibre, the bark of *Asclepias fruticosa*, the bulb of *Hypoxis rigidula*, and the leaves of *Helichrysum* sp.

A fibrous material derived from a marine plant, *Posidonia australis*, from South Australia, and a sample of Raphia bass from Sierra Leone were examined. Specimens of coir fibre from Sierra Leone were reported on, and a memorandum was

forwarded to the Colony describing the methods of preparing the fibre for export.

1907.—A small consignment of the fibre of *Asclepias semilunata* ("Kafumba" fibre) was received from Uganda. This product was of excellent quality and strength and contained a very large proportion of cellulose (88·1 per cent.). It would be useful for the manufacture of rope and twine and would be readily saleable in large quantities at about £28 to £33 per ton.

Fibrous material from *Securidaca longepedunculata* ("Buaze" fibre) of Nyasaland was investigated. The product was found to contain a useful fibre, which, however, could not easily be freed from the gummy matters associated with it. It was recommended that attempts should be made locally to extract the fibre in a clean condition from the fresh material.

Other samples examined included pineapple fibre from the Gold Coast, bark-cloth from Uganda, various fibrous materials from Southern Nigeria, *Orthanthera viminea* from India, the bark fibre of *Acacia cyanophylla* from Natal, and *Xanthorrhœa Preissii* from Western Australia.

RUBBER.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples under investigation at the end of 1907.	No.
India	2	India	6	India	3
Federated Malay States.	17	Federated Malay States.	1	Sierra Leone ...	10
Sierra Leone ...	13	Gambia	1	Gold Coast ...	11
Gold Coast ...	7	Sierra Leone ...	9	Southern Nigeria	5
Southern Nigeria	2	Gold Coast ...	26	Portuguese East Africa.	15
Senegal	1	Southern Nigeria	3	Rhodesia... ...	1
Liberia	3	Northern Nigeria	1	Jamaica	1
Sudan	15	Portuguese West Africa.	1	British Guiana ...	20
Abyssinia... ...	4	East Africa Protectorate.	3		
Uganda	5	Portuguese East Africa.	2		
Portuguese East Africa.	1	Natal	2		
Natal	2	Cape Colony ...	4		
Rhodesia	1	Transvaal ...	3		
		Rhodesia ...	2		
		Trinidad... ...	25		
		Formosa... ...	1		
Total... ...	73	Total... ...	90	Total... ...	66

A large number of specimens of rubber have been investigated in order to determine their intrinsic and commercial

value, to throw light on obscure points connected with their preparation, or as a basis for deciding questions as to the cultivation of the plants which furnish them.

1906.

India.—Samples of the rubber of *Cryptostegia grandiflora* and *Parameria glandulifera* were reported on during 1906.

The *Cryptostegia grandiflora* rubber was forwarded from Bombay, where the plant is stated to be very common. Specimens of this rubber from Madras and the Central Provinces had been previously examined at the Imperial Institute. The rubber from Bombay was found to be of very fair quality, although contaminated with earthy matter. There is no doubt that carefully prepared consignments of the rubber would be readily saleable (*see* "Bulletin of the Imperial Institute," 1907, V., 371).

The *Parameria glandulifera* rubber from the Andaman Islands was briefly referred to in the report for 1905 in connection with the similar samples from Burma. The rubber was of good quality judging from its chemical composition, but its value was depreciated by the external stickiness of the balls, probably caused by overheating during preparation or in transit (*see* "Bulletin of the Imperial Institute," 1907, V., 14).

Federated Malay States.—Sixteen samples of Para rubber (*Hevea brasiliensis*) which had been specially prepared in the Federated Malay States were reported on. The rubbers showed a very high degree of purity, the percentages of true caoutchouc ranging from 92·64 to 96·35 per cent. Four of the specimens contained over 95 per cent. of caoutchouc and seven others between 94 and 95 per cent. of this constituent (*see* "Bulletin of the Imperial Institute," 1907, V., 246).

A specimen of diseased bark from Para trees in the Federated Malay States was also examined, and suggestions were made for further action on the spot.

Sierra Leone.—The rubbers from this Colony reported on in 1906 included "Jenje," "Gbogboi," and "Njawa" rubbers, and ten samples of Landolphia rubbers.

The "Jenje" rubber is derived from a vine know as Poré, which has not been identified with certainty. From botanical specimens accompanying the rubber, the plant appears to be a Landolphia very near *L. owariensis*, Beauv. The rubber is of good quality.

The "Gbogboi" rubber was obtained in the Panguma district, and was of considerable interest, as the leaves which accompanied the specimen appeared to belong to *Funtumia elastica*, Stapf, the well-known Lagos rubber tree, the presence of which in Sierra Leone had not been definitely recorded. This determination has since been confirmed, and

the fact that *Funtumia elastica* is indigenous in the country is of considerable importance in connection with rubber planting in Sierra Leone. The sample of "Gbogboi" rubber submitted was rather sticky and contaminated with vegetable impurities, but carefully prepared specimens would be of good quality and readily saleable at satisfactory prices.

The "Njawa" rubber is of inferior quality on account of the large amount of resin (22 per cent.) which it contains. The botanical source of this rubber is uncertain (*see* "Bulletin of the Imperial Institute," 1906, IV., 29).

Ten samples of Landolphia rubber were specially prepared by the Curator of the Botanic Station in Sierra Leone in order to demonstrate that the quality of the rubber could be greatly enhanced by the adoption of improved methods of preparation.

The results of the chemical examination and valuation of the samples show that the rubber prepared in sheets or "biscuits" will realise much better prices than the same rubber made into balls by the usual native process. This conclusion confirms the results of similar experiments on the preparation of Landolphia rubber which have been conducted in other parts of tropical Africa.

Gold Coast.—The seven samples from the Gold Coast which were reported on in 1906 included specimens of the following rubbers: (1) Ceara rubber from *Manihot Glaziovii;* (2) Assam rubber from *Ficus elastica;* (3) "Memleku" rubber from *Ficus Vogelii;* "Krepi" ball rubber from *Landolphia owariensis;* and (5) Ofruntum rubber from *Funtumia elastica* (*see* "Bulletin of the Imperial Institute," 1907, V, 248).

The Ceara rubber was in the form of "scrap," and was found to be of very fair quality.

The *Ficus elastica* rubber, which was also in the form of "scrap," contained a little more resin than is desirable (11·6 per cent.), but was otherwise of good quality.

The "Memleku" rubber from *Ficus Vogelii* is of very resinous character, the two samples examined containing 44 per cent. of this constituent. The rubber is, therefore, of inferior quality, and would only realise a comparatively low price.

The "Krepi ball" rubber from *Landolphia owariensis* was of very good quality, containing over 91 per cent. of caoutchouc and only small quantities of resin and proteids.

The two samples of "Ofruntum" rubber from *Funtumia elastica,* prepared in "biscuit" form, were both of good quality, and the valuation obtained for one of them was almost equal to the current quotation for fine hard Para rubber from South America.

Southern Nigeria.—A specimen of *Funtumia elastica* rubber was examined and found to be of very fair quality, though capable of considerable improvement by better preparation.

Botanical specimens of a rubber plant were also submitted for identification.

Senegal.—A sample of *Landolphia Heudelotii* rubber prepared at the Rubber School of Banfora, Upper Senegal-Niger, was received from His Majesty's Consul-General at Dakar through the Foreign Office. The rubber was very well prepared and of good quality.

Liberia.—Three "lump" rubbers from Liberia were examined. They were found to be satisfactory in composition and in physical properties, but possessed very objectionable odours. These rubbers could be greatly improved by more careful preparation.

Sudan.—In continuation of the work in connection with the rubber resources of the Bahr-el-Ghazal, 15 samples of rubber from that province were reported on during 1906. The specimens represented the rubber of *Landolphia owariensis* var. *tomentella* prepared in "biscuits," cakes, and scrap. The results of the examination fully confirm the high opinion which had been previously formed of the quality of this rubber. Some of the "biscuits" were valued by brokers in London at the same price as Para "biscuits" from Ceylon and the Federated Malay States.

Abyssinia.—Four samples of rubber from Abyssinia were received through the Sudan Government. The rubber is of very fair quality, although the percentage of resin in all the samples is a little high; if carefully prepared it would be readily saleable. This rubber is derived from a species of Landolphia which has not been definitely identified.

Uganda.—Specimens of the rubbers of *Funtumia elastica*, *Clitandra orientalis* and *Landolphia Dawei* from this Protectorate were reported on in 1906 (*see* "Bulletin of the Imperial Institute," 1906, IV, 202).

All the samples were well prepared and exhibited good physical properties. In consequence high valuations were obtained, the prices quoted being only a little below the current values of Para "biscuits" from Ceylon and the Federated Malay States.

Portuguese East Africa.—A small specimen of rubber, described as Ceara, from this territory was examined and found to be of good quality.

Natal.—A small consignment of "Ibungu" rubber derived from *Landolphia Kirkii* in Natal was received, and after analysis which showed it to be of good quality, it was sold in London at a very satisfactory price.

A succulent root supposed to contain rubber was also examined.

Rhodesia.—A rubber-like material, the botanical source of which was unknown, was examined and found to be very resinous and of little commercial value.

1907.

India.—The rubbers from India reported on in 1907 included specimens derived from (1) *Ficus elastica*, (2) *Hevea brasiliensis*, (3) a climber from Central India, and (4) a species of *Euphorbia*.

Two samples of *Ficus elastica* rubber from the Kulsi plantation were both found to contain a rather high percentage of resin. One of them was otherwise of satisfactory quality, and consignments of similar character would be readily saleable; the other specimen was soft, sticky and rather weak, and would therefore be difficult to sell.

A specimen of *Ficus elastica* rubber collected by natives in Northern Arakan was also received. It was very impure, and a better specimen has been requested.

An excellent sample of Para rubber was forwarded from the Mergui plantation. It contained 95·2 per cent. of caoutchouc, 1·6 per cent. of resin, and 2·4 per cent. of proteid. In composition and physical properties this rubber compares favourably with Para rubber from Ceylon and the Federated Malay States (*see* "Bulletin of the Imperial Institute," 1907, V, 371).

The rubber obtained from a climbing plant in Central India was found to contain rather high percentages of resin and mineral impurity. This rubber may possibly have been derived from *Cryptostegia grandiflora*.

A resinous material, possibly derived from a species of *Euphorbia*, was examined and found to be of no commercial value.

Federated Malay States.—A special sample of gutta percha prepared by tapping the standing trees was forwarded by the Conservator of Forests in the Federated Malay States and Straits Settlements. The material was found to be of excellent quality, containing a higher percentage of "gutta" than is usually present in the better grades of gutta percha which appear in commerce.

Gambia.—A specimen of *Ficus Vogelii* rubber from this Colony was found to contain less resin than samples from other parts of West Africa previously examined at the Imperial Institute. A larger sample of the rubber has been requested for technical trials.

Sierra Leone.—Five samples of rubber collected in the Gola Forest were examined. Four of them were of very promising quality, and if carefully collected and prepared the rubber

would command satisfactory prices in the market. The fifth specimen contained a large amount of resin, which would reduce its value. No information is available regarding the identity of the plants from which these rubbers were obtained, but botanical specimens have been asked for.

Further samples of Landolphia rubbers and of *Funtumia elastica* rubber were also submitted.

A comparative examination of Landolphia rubber prepared (1) in sheets by an improved method, and (2) in balls by the ordinary native process, again showed that the former would realise the best price.

Two specimens of *Funtumia elastica* rubber in biscuits were examined and shown to be of good quality, containing 90·5 and 91·2 per cent. of caoutchouc, respectively.

Gold Coast.—A series of 21 samples of *Funtumia elastica* rubber prepared in "biscuit" form was forwarded from Ashanti. With two exceptions the specimens were of very promising quality, and the valuations obtained showed that the rubber in this form would realise much higher prices than the ordinary native lump rubber.

Four other samples of Funtumia rubber, and one specimen of *Ficus Vogelii* were also dealt with during the year.

The Funtumia rubber was prepared by different methods, including the use of an infusion of the leaves of *Bauhinia reticulata* for coagulating the latex. They were all of good quality, and very satisfactory valuations were obtained for them. The use of a hot infusion of the leaves of *Bauhinia reticulata* for coagulating Funtumia latex appears to give very good results. The infusion is acid and contains tannin, of which 8 per cent. is present in the dry leaves. It seems probable that the tannin is the active coagulating agent as it has been found that solutions of gallo-tannic acid and infusions of astringent materials such as the pods of *Acacia arabica* exert a similar action. This method of preparing Funtumia rubber promises to yield very satisfactory results, as it entirely obviates the necessity of applying heat directly to the latex.

The *Ficus Vogelii* rubber examined contained 35·6 per cent. of resin, which is rather less than was found in the two previous specimens from the Colony. A small consignment of this rubber has been asked for so that technical trials can be made.

Southern Nigeria.—Two samples of Funtumia rubber were forwarded but proved to be too small for chemical examination. Very satisfactory valuations were, however, obtained.

The latex from a species of Mimusops, probably *M. Djave*, has been investigated. The product obtained on coagulation is of resinous character and would have very little commercial value.

Northern Nigeria.—A sample of "Kano rubber," derived from *Ficus platyphylla* was forwarded from Katsena. It was found to be similar in composition to previous samples.

East Africa Protectorate.—A specimen of rubber obtained from a tree growing on the Shimba Hills was examined and found to be of very fair quality. The rubber could be improved by careful preparation as the sample contained a considerable amount of vegetable impurity. The tree yielding this rubber has since been identified as *Mascarenhasia elastica* K. Schum.

The rubber obtained from a vine growing in the country to the South of Kericho was of very fair quality, although the percentage of resin (11·6) was a little high. The identity of the vine which furnished this rubber is not known, but botanical specimens have been asked for with a view to its determination.

A small quantity of latex, stated to be derived from a species of Cactus growing in the Protectorate, was examined, but the product was very resinous and unsuitable for technical use.

Portuguese East Africa.—Samples of latex and of the coagulated product obtained from it were forwarded by His Majesty's Consul at Beira. The material was thought to resemble "gutta-percha" in properties, but no information was available regarding either its botanical or exact geographical source. The product consisted largely of resin and would have little, if any, commercial value.

South Africa.—A number of specimens of the latex and coagulated product obtained from different species of Euphorbia have been forwarded from Natal, Cape Colony, the Transvaal and Rhodesia. All the samples have proved to be of resinous character, and on that account it would be difficult to utilise them for any important technical purpose. The commercial value of such material would only be very low and would probably not repay the cost of collection and transit.

Trinidad.—Twenty-five samples of rubber from Trinidad have been examined. The collection included specimens of the rubbers of *Hevea brasiliensis* (Para rubber), *Funtumia elastica* and *Castilloa elastica* obtained from trees growing on lands belonging to the Botanical Department or on private estates.

The Para rubber is of very good quality, two specimens in "biscuit" form containing 94·9 and 92·7 per cent. of caoutchouc, respectively. Very satisfactory valuations were obtained for the samples.

Several of the samples of Castilloa rubber were of inferior quality on account of the large amounts of resin present. Two specimens from 7½-year old trees growing on lands

belonging to the Botanical Department contained 52 and 57 per cent. of resin, respectively. These percentages are very high for the product of 7½-year old trees, but it may be noted that the trees in question are stated to be of small growth owing to the fact that they have been outgrown by surrounding Para trees.

The Castilloa rubber from private estates was less resinous on the whole than the above specimens, for although one sample contained 37·2 per cent. of resin the amount present in the remaining specimens ranged from 15·6 to 23 per cent. Even these latter percentages are much higher than those usually recorded for Castilloa rubber from adult trees. It will be of interest to see whether the average percentage of resin in the Castilloa rubber obtained in Trinidad will diminish as the trees become older.

The single specimen of Funtumia rubber was of very fair quality.

In addition to the above specimens, samples of Loranthus rubber and of balata from Venezuela were included in the collection.

Formosa.—A specimen of the rubber obtained from a vine discovered in Formosa, and identified as *Ecdysanthera utilis*, was forwarded by His Majesty's Consul at Tamsui. It was found to be of good quality so far as chemical composition is concerned, and if carefully prepared would be readily saleable at satisfactory prices.

Timbers.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Uganda	18	Southern Nigeria	26	Gambia	2
Foreign countries	1	Uganda	52	Sierra Leone ...	1
		East Indies ...	2	Rhodesia... ...	1
		West Indies ...	1	Sudan	10
				Mauritius ...	12
Total... ...	19	Total... ...	81	Total... ...	26

Uganda.—The 70 timbers received from this Protectorate in 1906 and 1907 were representative of the materials obtainable in the Mabira or Chagwe Forest and other parts of the Protectorate recently explored by the Forestry Officer of Uganda, and included a number of interesting woods, such as "African Blackwood" and several timbers which would be saleable as mahogany.

Southern Nigeria.—This set of 26 samples represented some of the chief woods obtainable in this Colony, and information was supplied regarding their working qualities and mechanical properties. A number of these timbers will be suitable for export to the United Kingdom if the cost of collection and transport does not prove to be too high.

East and West Indies.—The three timbers included in this group were samples of woods which were stated to cause skin diseases in operatives working with them. All three woods were found to contain interesting substances, which are still under investigation.

The samples awaiting investigation at the end of the year included mahogany and rosewood from the Gambia and a number of interesting hard woods from Mauritius and the Sudan.

The timbers received have been tes[illegible] their working qualities, and when suitable and suffici[illegible] large specimens were received the timbers were also submitted to mechanical tests, so that their strength and other physical characters might be ascertained.

Oils and Oil-seeds.

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Sudan	13	Sudan	8	Sudan	1
Uganda	1	British East Africa	1	Uganda	4
Rhodesia	1	Rhodesia... ...	9	Rhodesia... ...	2
Cape Colony ...	1	Gold Coast ...	1	Sierra Leone ...	3
Southern Nigeria...	3	Sierra Leone ...	1	Southern Nigeria	3
Northern Nigeria...	3	Southern Nigeria	7	Northern Nigeria	2
Hong Kong ...	2	Northern Nigeria	3	India	6
West Indies ...	1	India	4	Foreign countries	2
United Kingdom...	1	Ceylon	1		
		Source unknown	1		
Total... ...	26	Total... ...	36	Total... ...	23

In view of the scarcity of oils and fats suitable for soap manufacture during 1906-7, special attention was directed to the examination of vegetable oils.

1906.

Cape Berry Wax.—A sample of Cape berry wax, derived from a species of *Myrica*, was received for examination from Cape Colony. The properties of this substance indicated that it might be utilised for soap-making and possibly for the

manufacture of candles. The product was regarded as worth about 25*s.* per cwt., and a trial consignment was requested.

"*Ikpan*" *Seeds.*—A sample of "Ikpan" seeds, probably derived from a plant of the *Cucurbitaceae*, was received from Southern Nigeria. These seeds were found to yield an oil, which would probably be useful as an edible product, whilst the cake left after expressing the oil would be of value as a cattle food.

Seeds of Aleurites spp.—Specimens of the seeds of *Aleurites triloba* and *A. Fordii* were forwarded for examination from Hong Kong. The kernels of the former species were found to contain 60·8 per cent. of an oil which could be employed for the manufacture of soft soap or as a substitute for linseed oil for paints and varnishes. The kernels were valued at £12 to £13 per ton. It was recommended that the shells should be removed from the seeds and the kernels only exported.

The seeds of *A. Fordii* yielded an oil which resembled the T'ung oil of commerce.

Seeds of Carapa grandiflora. These seeds from Uganda were examined and found to contain an oil which would probably be useful for soap-making and worth about £22 per ton. A consignment was requested for technical trials.

Castor Oil Seed.—Seven samples of castor oil seed from the Sudan were found to be of average quality and worth £11 to £12 per ton.

Beeswax.—Three samples of beeswax were received from the Sudan. One was of rather dark colour and worth about £6 per cwt. The others were somewhat dirty, but when purified by melting and straining, the product was in each case regarded as worth £7 per cwt.

Among other products examined may be mentioned samples of the oil and oil-cake obtained from the seeds of *Moringa pterygosperma* from Northern Nigeria, ground nuts, sesame and linseed from the Sudan, palm kernels from Southern Rhodesia, seeds of *Thevetia neriifolia* from Southern Nigeria, and ground nuts and oil from Northern Nigeria.

1907.

Shea Nuts and Butter.—Four samples of shea nuts, the seeds of *Butyrospermum Parkii*, and one sample of the fat (known as "Shea butter") extracted from these seeds were received for examination from Southern Nigeria. Shea butter could be used for the manufacture of candles or soap, although it would be more suitable for the latter purpose if a variety can be found nearly free from unsaponifiable matter. It was valued at £27 5*s.* to £27 10*s.* per ton.

sesame seed from Rhodesia, seeds and fat of *Pentadesma butyracea* from Sierra Leone, "Ikpan" seeds and the berries and oil of a Sapindaceous plant from Southern Nigeria, ground-nut oil from Northern Nigeria, *Amoora Rohituka* oil from India, vegetable waxes from South Africa and Mexico, and "M'Fucuta" seeds from Portuguese East Africa.

Summaries of reports of the investigations of various African oils and oil-seeds have been published in the "Bulletin of the Imperial Institute," 1908, VI., 243, 353.

The following investigations were in progress at the end of the year:—The examination of 20 samples of palm fruits and oil of different varieties from the Gold Coast; specimens of "ben" oil seeds from Northern Nigeria; and seeds of *Pentaclethra macrophylla* from Sierra Leone and Southern Nigeria. A study was also being made of the production of stearin from Indian cotton-seed oil and, in connection therewith, a comparative examination of Indian "ghi" from buffaloes' and cows' milk was being carried out.

Volatile Oils.

Countries of Origin.—Cyprus, Uganda, Gold Coast, Seychelles, Ceylon, India, Fiji, Bermuda.

Number of volatile oils received in 1908	...	59
Number of volatile oils reported on in 1908	...	10

The volatile oils received during the year consisted mainly of "grass oils," such as "lemon grass" and "citronella," turpentine oils, and origanum and marjoram oils.

Lemongrass Oils.—These were received from Uganda, Ceylon, Fiji, and Bermuda. Both the Bermuda and Uganda oils were somewhat low in citral, the principal odoriferous constituent of lemongrass oil, and were, consequently, of small value. Unfortunately, the market for lemongrass oil was for the greater part of the year so overstocked that this oil was practically unsaleable.

Citronella Oil.—A sample of this was received from the Gold Coast. It was of rather abnormal character, and information as to its botanical origin is being sought.

A very complete series of "grass oils" has been received from Ceylon and is at present under investigation.

Oils from Origanum sp.—These were received from Cyprus. They included two samples of origanum oil, portions of consignments offered for sale in London by the Government of Cyprus. The samples were of the usual good quality, and contained about 80 per cent. of carvacrol. It has been ascertained that better prices might be obtained for this origanum oil in commerce if it were rectified so as to remain colourless when kept. A process of rectification was devised during the year, and this will be tried on a large scale in Cyprus in the coming season, and for this purpose a modern rectifying still is being specially constructed in London.

The preparation of pure carvacrol, on a commercial scale, from this oil has also been suggested to the Government of Cyprus, and a small trial consignment of this carvacrol has been sold recently to a London firm. Cyprus marjoram oil is being completely investigated with a view to ascertaining whether it is identical with the sweet marjoram oil of commerce. The exact botanical origin of each of these oils has not yet been settled, and this point is being investigated at the Royal Gardens, Kew.

Turpentine Oils.—These were received from India. A full investigation is being made of these oils in comparison with American, French, and Russian turpentine oils.

Various Oils.—These included laurel oil from Cyprus, which proved to be of excellent quality, and bay oils from Fiji, which are still under investigation. Among products yielding aromatic oils on distillation, were clove leaves from Seychelles, which furnished 4·5 per cent. by weight of the clove-leaf oil referred to in the Report on the work of the Imperial Institute in 1906 and 1907 (p. 61), and *Chlorocodon* roots from Uganda, from which a new aromatic isomeride of vanillin was isolated. Certain other products of this type which have been investigated are dealt with under spices (*see* p. 40).

Food-Grains, Feeding-Stuffs, and Spices.

Countries of Origin.—Sudan, Uganda, Rhodesia, Natal, Transvaal, Cape Colony, Northern Nigeria, Southern Nigeria, Sierra Leone, St. Helena, Seychellés, India, Federated Malay States, Western Australia, Fiji, Falkland Islands.

Number of food-grains, feeding-stuffs, and spices received in 1908...	29
Number of food-grains, feeding-stuffs, and spices reported on in 1908	40

Food-grains.

Maize.—A large number of samples of this cereal were received from Southern Nigeria and reported on. Some were of good quality and were valued at satisfactory prices, others were badly attacked by weevils. As a good deal of interest is being taken at present in this product, in both West and South Africa, an article on the cultivation and preparation of maize was published in the "Bulletin of the Imperial Institute," 1908, VI., 261, to which numerous enquirers were referred during the year.

Various Food-grains.—The article on "Mazzagua corn," published in the "Bulletin of the Imperial Institute," 1906, IV., 226, has stimulated interest in this product in countries liable to suffer from drought, and in response to numerous requests for supplies of seed, a small consignment was obtained from Northern Nigeria this year, and distributed. Among new or little-known food-grains examined were *Eleusine coracana* grain from Uganda, valued at £4 to £5 per ton, c.i.f. London; "Tamba" millet,

"Paruru" seeds, and "Wanke" beans from Northern Nigeria; "grey" and "brown" millets from Southern Nigeria, valued at 22*s*. and 20*s*. per quarter, c.i.f. London respectively; whilst "Gorley" seed from Sierra Leone, *Crotalaria juncea* seed from the Federated Malay States, and "macaroni" wheat from India, were still under investigation at the end of the year.

Starch Products.—A considerable amount of interest has been shown during the year in certain starches, particularly arrow-root, cassava starch, and sweet-potato starch, and information has been supplied, mainly to West and South African Colonies, on machinery and processes for preparing starch from cassava and sweet potatoes; samples of these products from Natal, Sierra Leone, and Fiji have been received for examination during the year. Most of the specimens were of good quality and readily saleable.

Spices.—The investigations have related mainly to vanilla, cinnamon bark, and ginger. Samples of the two former were received from Seychelles, where a new industry, in the production of cinnamon bark, has sprung up, and the investigations conducted at the Imperial Institute show that although the bark is roughly prepared and only suitable, as a rule, for manufacturing purposes, it gives a fairly satisfactory yield of cinnamon oil of good quality, and suggestions for the better preparation of the bark have been made. A sample of ginger from Southern Nigeria proved to be of fair quality, and worth 48*s*. to 50*s*. per cwt. During the year assistance has been continuously afforded to producers of ginger in Sierra Leone in valuing and disposing of their produce in London.

Various Products.—Samples of cocoa have been received from Fiji for valuation. An examination of a native tea from Cape Colony was made; it is derived from a species of Cyclopia, and was found to contain no caffeine. A memorandum on the testing of hams for boric acid was prepared for the Local Government Board.

Tanning Materials.

Countries of Origin.—British East Africa, Natal, Northern Nigeria, Gold Coast, Gambia, India, Portuguese East Africa.

Number of tanning materials received in 1908...	16
Number of tanning materials reported on in 1908	18

The tanning materials examined during the year belong to three groups:—

1. *Mangrove Products.*—Three mangrove barks, from Portuguese East Africa, were found to contain 23·3, 28·3, and 41·76 per cent. of tannin. The samples were of special interest, because No. 2, on further examination, was found to contain 39·8 per cent. of tannin in the inner bark, and only 8·97 per cent. in the outer bark, clearly illustrating the desirability of scraping the outer layers off mangrove bark before shipment. A mangrove bark from the Gambia was of exceptional interest in

yielding a very light-coloured leather, but unfortunately it contained only 25·7 per cent. of tannin.

The enquiry on the manufacture of Indian mangrove extracts, referred to in the Report for 1906-7 (p. 67), was completed during the year. Mangrove leaves from British East Africa were also examined, but proved to contain too little tannin and too much salt to be of value as a tanning agent.

2. *Wattle Barks.*—A number of enquiries have been received relating to this product during the year, and information has been furnished to the Government of Natal respecting machinery and processes for making wattle extract, and also regarding the competition of other tanning materials with wattle bark in the United Kingdom. Six samples of wattle bark were examined for the Natal Government, mainly with a view to ascertaining the influence of the situation of a wattle plantation on the bark produced. These results are summarised *inter alia* in articles in the "Bulletin of the Imperial Institute," 1908, VI., 157 and 417.

Cæsalpinia Pods.—"Divi-divi" pods from the Gold Coast proved to be not well prepared and deficient in tannin. Further supplies of "teri" pods were received from India during the year, and were submitted to commercial firms for trial and valuation.

Acacia Pods.—Acacia arabica pods from Northern Nigeria were found to contain 26·6 per cent. of tannin.

Full particulars regarding most of these tanning materials and of others investigated at the Imperial Institute in recent years are given in reports and articles published in the "Bulletin of the Imperial Institute," 1907, V., 343; 1908, VI., 121, 167, 175, and 417.

Natural Dyestuffs.

Countries of Origin.—Northern Nigeria, Southern Nigeria, Sierra Leone, India, Jamaica.

Number of dyestuffs received in 1908 ...	...	17
Number of dyestuffs reported on in 1908	...	15

Natural dyestuffs are now of so little importance in commerce that their investigation is generally of more purely scientific than practical importance. There are, however, still a few natural dyestuffs which for certain purposes have not been entirely supplanted by aniline and other artificial dyes. Among the most important of these are logwood, camwood, annatto, quercitron bark and natural indigo, and enquiries relating to, or samples of, all these products have been dealt with in the course of the year. There has been some revival of interest in Indian indigo, chiefly on account of the planting experiments with Natal-Java indigo, which have been carried on during the last few years in India. This species furnishes a superior yield of indigo, and a number of enquiries on the subject were dealt with. Owing to a failure in demand for Jamaica logwood, enquiries were received from that island as to the market and prospects for this wood in Europe, and a memorandum on the subject was

prepared, and enquirers were placed in a position to negotiate directly with consumers in this country.

Other enquiries dealt with the method of formation of the red-colouring matter in camwood, the preparation and value of quercitron bark, and the identification of samples of saffron.

An interesting series of materials used in tanning and dyeing the native leather of West Africa was received during the year, and a full account of these, with details of the method of using them, was published in the "Bulletin of the Imperial Institute," 1908, VI., 175.

Resins.

Countries of Origin.—Uganda, Southern Nigeria, Northern Nigeria, Gold Coast, Sierra Leone, India, Fiji.

Number of resins received in 1908	...	...	16
Number of resins reported on in 1908	...	...	14

The resins examined during the year fall into four well-marked groups, as follows:—

Copals.—Samples of these were received from the Gold Coast, Sierra Leone, and Southern Nigeria, mainly in connection with an investigation into the botanical sources of West African copals, which is being carried on by the Inspector of Agriculture for West Africa. The results so far obtained are summarised in the "Bulletin of the Imperial Institute," 1908, VI., 245. A copal from a new district in the Gold Coast proved to be of very good quality, and, after cleaning and grading, was valued at 70*s.* per cwt.

Elemi.—Samples of elemi-like resins were received from Southern and Northern Nigeria and Uganda. They proved to be somewhat similar to Manila elemi in composition, but were not so clean and well-prepared.

The information available regarding these African elemis is given in the "Bulletin of the Imperial Institute," 1908, VI.., 252.

Dammars.—These were received from India and Fiji. The former was obtained for trial by a firm of crêpe manufacturers as a possible substitute for shellac, but it proved to be not quite suitable for this purpose.

Colophony.—Crude turpentines from the chief Indian species of Pinus were received, as well as the corresponding colophony prepared in India. These were under investigation at the end of the year.

Gums.

Countries of Origin.—Northern Nigeria, Southern Nigeria, Gold Coast.

Number of gums received in 1908	...	...	13
Number of gums reported on in 1908	...	...	30

Of the gums from British Colonies only one from Northern Nigeria and two from the Gold Coast were of a type likely to

be saleable in this country. The Nigerian gum was from *Acacia Caffra*, and proved to be very similar in quality to that yielded by *Acacia Senegal* in the Sudan and Senegambia, which constitutes the bulk of the gum arabic of commerce. The gums of *Acacia sieberiana* and *Pseudocedrela Kotschyi* from the Gold Coast were rather dark-coloured, but would no doubt be saleable at low prices.

Among the gums from foreign countries are included a series obtained at Trieste by the Director of the Imperial Institute. These represented the crude gums imported into Trieste and the graded products prepared there. A full account of the results of the examination of these materials has been published in the "Bulletin of the Imperial Institute," 1908, VI., 40.

A memorandum on the cultivation of tragacanth trees and the preparation of tragacanth gum for the market was supplied to the Government of Bermuda.

Drugs.

Countries of Origin.—British East Africa, Transvaal, Cape Colony, Gold Coast, Sierra Leone, Southern Nigeria, Northern Nigeria, Seychelles, India, Straits Settlements and Federated Malay States, Fiji.

Number of drugs received in 1908	16
Number of drugs reported on in 1908	16

East Africa Protectorate.—Two samples of "Muziga" or "Ol-sogonoi" mark, identified at Kew as the product of *Warburgia ugandensis*, were received, and found to contain mannitol (about 3 per cent.), tannin, and a pungent resin, soluble in ether.

Cape Colony.—The leaves, &c., of *Senecio latifolius*, a plant well known to be poisonous to cattle, were examined. The sample collected before flowering was found to contain 1·72 per cent. of alkaloid, whilst that collected after flowering yielded 0·76 per cent. The alkaloidal product was separated into senecifoline and senecifolidine, both of which are crystalline. The former alkaloid was examined by Professor A. R. Cushny, F.R.S., and found to be physiologically active. A further supply of material was requested in order that the investigation might be continued.

From the bulbs of *Ornithoglossum glaucum*, an amorphous, bitter principle was isolated, which was very soluble in water, and was found by Professor Cushny to exert a physiological action resembling that of digitalin.

Sierra Leone.—*Ageratum conyzoides* ("Craw-craw") was examined and found to contain a minute quantity of a crystalline alkaloid, to which the physiological activity of the drug may possibly be due.

An examination of the leaves of *Cassia alata* showed that neither an alkaloid nor a glucoside is present, but the active principle is contained in the resin acids and acts as a mild

purgative. The leaves of the same plant were also received from the Federated Malay States.

Southern Nigeria.—The pods of *Tetrapleura Thomingii* were investigated. Neither alkaloids nor cyanogenetic glucosides were present, but the soft pulp was found to contain sugars, tannin, and a small quantity of "saponin," to which the detergent property of the fruit is due.

Seychelles.—The fruits and seeds of *Cerbera Odollam* and *Brehmia* (*Strychnos*) *spinosa* were received. The seeds of the latter plant were not bitter, and did not contain strychnine or any other alkaloid.

Straits Settlements.—Samples of the stem, leaves, and decoction of the "Kiki" plant, which has been recommended as an anti-opium remedy, were examined. Phlobaphenes, gummy matter, and sugars were present, but nothing could be detected which was likely to be physiologically active.

India.—In reply to an enquiry from the India Office, a memorandum was supplied giving information with regard to the principal sources of opium, the cultivation of the opium poppy, the preparation of the drug, and the values, uses, and quality of the chief commercial varieties.

At the close of the year, the following drugs and poisonous plants remained under investigation:—*Dichapetalum* leaves from the Transvaal; the bark of *Pentaclethra macrophylla*, and three native drugs ("Anet," "Ebonka," and "Tatuokroo") from Sierra Leone; wild kola seeds from Southern Nigeria; three native drugs from Northern Nigeria; "Tonga" bark and root from Fiji; and the roots of *Thalictrum foliolosum* from India. Considerable progress was made with the investigation of Indian species of Aconite, Hyoscyamus, Datura, and Strychnos, but these enquiries are not yet completed.

Plants Reputed to be Poisonous to Cattle

Countries of Origin.—Sudan, Rhodesia, Transvaal, Cape Colony, India, Trinidad, United Kingdom.

Number of plants received in 1908	19
Number of plants reported on in 1908	16

In addition to the poisonous plants referred to under "Drugs," the following may be alluded to:—

Cyanogenetic Plants.—Included in these were the leaves of *Ximenia americana* from the Sudan. The fruits of this plant have been stated to yield prussic acid, but none could be detected in the leaves. A number of samples of the Rangoon beans sold in this country were supplied by the Board of Agriculture for examination, and samples of linseed cake alleged to have proved poisonous to cattle were also examined. A full account of the results of this work was published in the "Journal of the Board of Agriculture," 1908, 14, 722. Living cassava plants of the "bitter" and "sweet" varieties were supplied by the Botanical

Department of Trinidad, with a view to ascertaining whether they contained *free* prussic acid. The results of examination showed that the acid was present in the form of the cyanogenetic glucoside phaseolunatin, first isolated from cassava at the Imperial Institute in 1907. At present, Para rubber seed and several other products known to yield prussic acid are under investigation in the Department, with a view to the isolation and identification of the cyanogenetic glucosides they contain.

Other Poisonous Plants.—Various plants from South Africa are at present under investigation in the Department, and from several of these interesting new products have been obtained which are being fully examined.

Tobaccos.

Countries of Origin.—Nyasaland, British East Africa, Uganda, Northern Nigeria, Southern Nigeria, Sierra Leone, India, West Indies, Bermuda, Greece, and Turkey.

Number of tobaccos received in 1908	28
Number of tobaccos reported on in 1908 ...	76

The most interesting of the tobaccos reported on were those from Northern Nigeria and British East Africa. The former was a tobacco grown from Virginian seed under European supervision, and was of a quality likely to be saleable in this country. One of the samples from British East Africa was a native tobacco, which burnt well and appeared to be of promising character. The others were all coarse native tobaccos, of no value for export purposes. At the end of the year, in connection with the work of the tobacco expert in Uganda, a sample of ash from vegetable refuse was under examination with a view to ascertaining its manurial value for tobacco plantations. The investigation of the representative samples of Greek and Turkish tobaccos, collected by the Director of the Imperial Institute during his visit to the Levant for the Colonial Office, was completed during the year. These samples were referred to in the Report for 1906-7 (p. 73).

Miscellaneous.

Countries of Origin.—Somaliland, Uganda, Southern Nigeria, Gold Coast, St. Helena, India.

Number of miscellaneous samples received in 1908	20
Number of miscellaneous samples reported on in 1908	20

These were products of little importance for the most part. They included "gusangus" root, used as a soap substitute in Somaliland; specimens of plants used in Southern Nigeria for hardening the floors of native huts; and samples of seeds and other products submitted, mostly by manufacturers and brokers in this country, for identification, and with requests for information as to their value and possible uses.

Insect and Fungoid Pests.

Countries of Origin.—British East Africa, United Kingdom.

Number of specimens received in 1908 12
Number of specimens reported on in 1908 ... 12

The specimens from British East Africa proved to represent fungoid diseases attacking the leaves and roots of sisal plants, and a number of insects which were identified.

Animal Products.

Countries of Origin.—Sudan, Uganda, Transvaal, Ceylon, Australia, Bermuda.

Number of animal products received in 1908 ... 58
Number of animal products reported on in 1908 60

Sponges.—These were received from the Sudan, Ceylon, West Australia, and Bermuda. The sponges from Bermuda were of a good and readily saleable quality. Those from West Australia were of peculiar shape, and for that reason were of rather doubtful value, though some of them were of types which would be saleable at low prices. The Sudan samples were promising, but on full investigation they proved to be unsuitable for the market in this country. All the sponges were zoologically identified for the Institute by the Zoological Department of the Natural History Section of the British Museum.

Ostrich Feathers.—These were from the Sudan, were all of good quality, and were valued at satisfactory prices by experts.

Other Animal Products.—The other products dealt with were country. All the sponges were identified for the Institute by the Zoological Department of the Natural History Section of the British Museum.

VIII.—SUBSIDIARY WORK.

Several Societies have made use of the Jehanghier Hall and the Colonial Conference Rooms for the holding of meetings, including the British Women's Emigration Association, the National Indian Association, and the Colonial Nursing Association.

The City and Guilds of London Institute were granted the use of a portion of the North Gallery for the display of specimens in connection with the examination of the practical work done under the auspices of the Technological Department of that Institute, and a small exhibition of woodwork was held by the same Department at the request of the Institute of Builders and the Architectural Association.

In connection with the British Columbia Development Association, an exhibition of British Columbia fruit was held at the Imperial Institute from the 15th to the 18th December, being opened on the first day by Lord Strathcona.

COLONIAL REPORTS.

The following recent reports relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
565	Colonial Survey Committee	1907–1908
566	Northern Territories of the Gold Coast	1907
567	Seychelles	"
568	Bermuda	"
569	Weihaiwei	"
570	Hong Kong	"
571	Malta	1907–1908
572	British Honduras	1907
573	Gold Coast	"
574	Nyasaland Protectorate	1907–1908
575	Bahamas	"
576	Gambia	1907
577	St. Vincent	1907–1908
578	Turks and Caicos Islands	1907
579	St. Lucia	"
580	Fiji	"
581	Mauritius	"
582	Straits Settlements	"
583	Southern Nigeria	"
584	Imperial Institute	1906–1907
585	Barbados	1907–1908
586	Somaliland Protectorate	"
587	Trinidad and Tobago	"
588	Sierra Leone	1907
589	British Guiana	1907–1908
590	Grenada	1907
591	Leeward Islands	1907–1908
592	East Africa Protectorate	"
593	Bechuanaland Protectorate	"
594	Northern Nigeria	"
595	Basutoland	"
596	Swaziland	"
597	St. Helena	1908
598	Gibraltar	"
599	Falkland Islands	"
600	Uganda	1907–1908

MISCELLANEOUS.

No.	Colony, &c	Subject.
51	Southern Nigeria	Forest Administration.
52	South Africa	Native Education.
53	East Africa Protectorate ...	Veterinary Bacteriological Work, 1907–08.
54	Newfoundland	Governor's Visit to the Micmac Indians.
55	Cape Colony	Rietfontein Area.
56	Turks Islands	Salt Industry.
57	Uganda	Governor's Tour.
58	British Colonies	Fibres.
59	Northern Nigeria	Mineral Survey, 1906–07.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By DARLING & SON, Ltd., 34-40, Bacon Street, E.

1909.

COLONIAL REPORTS—ANNUAL.

No. 656.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, 1909.

(For Report for 1908, *see* No. 601, [Cd. 4448-10] of 1909.)

Presented to both Houses of Parliament by Command of His Majesty.

October, 1910.

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1910.

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No. 656.

IMPERIAL INSTITUTE, 1909.

(For Report for 1908, *see* No. 601, [Cd. 4448–10.] of 1909.)

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE IN 1909. BY PROFESSOR WYNDHAM R. DUNSTAN, M.A., LL.D., F.R.S., *Director*.

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I.—PREFATORY STATEMENT.

THE IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA.

TRUSTEES.

The First Commissioner of His Majesty's Treasury.
The Secretary of State for the Colonies.
The Secretary of State for India.
The President of the Board of Trade.

ADVISORY COMMITTEE.

(Appointed under the provisions of the Imperial Institute Transfer Act, 1902.)

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The Hon. Sir W. Arbuckle, K.C.M.G.
Sir C. P. Lucas, K.C.M.G., C.B.
(One vacancy to be filled).

MANAGING COMMITTEE.

The Right Hon. Sir C. Clementi Smith, G.C.M.G. (nominated by the Colonial Office) (*till 31st August*, 1909).
C. A. Harris, Esq., C.B., C.M.G. (nominated by the Colonial Office) (*from 1st September*, 1909).
Sir Alfred Bateman, K.C.M.G. (nominated by the Board of Trade).
Colonel Duncan G. Pitcher (nominated by the India Office).

DIRECTOR.

Professor Wyndham R. Dunstan, M.A., LL.D., F.R.S.

The Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May, 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of the Colonies and India, and providing for their investigation and for the collection and dissemination of scientific, technical, and commercial information relating to them.

The work of the Imperial Institute is at present carried on under four principal divisions: (1) the Colonial and Indian collections,

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consisting mainly of raw materials and primary manufactures displayed in the public exhibition galleries, and including a Central Stand for receiving enquiries and distributing publications; (2) the Scientific and Technical Department, including a special staff and research laboratories, occupying the second floor of the building; (3) the Reference Library, containing a large collection of works of reference relating to the Colonies and India, together with the principal periodicals and newspapers; (4) the *Bulletin of the Imperial Institute*, a quarterly publication containing a record of the work of the Imperial Institute in its various branches, as well as special articles on subjects connected with the industrial utilisation of mineral and vegetable products.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which His Royal Highness the Prince of Wales (afterwards King Edward VII.) was President, and an Executive Council, including representatives of the Indian Empire and of all the British Colonies and Dependencies. In 1900 the building became the property of His Majesty's Government, by whom the western portion and galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portions being assigned for occupation by the University of London. In July, 1902, an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee, including representatives of the Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture and the Board of Trade. This Act took effect on January 1st, 1903.

On October 1st, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A Committee of Management of three members, one nominated by each of the three Government Departments chiefly concerned, has been appointed.

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and to the commercial utilisation of economic products.

The following are the principal departments of the Institute:—

Exhibition Galleries.—Colonial and Indian Collections.—The collections of economic products and other exhibits illustrative of the general and commercial resources of the Colonies and India are arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday,

and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter. The following British Colonies and Dependencies are represented by collections, which are in charge of Technical Superintendents:—Canada, Newfoundland, Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahama Islands, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda, Falkland Islands, New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, New Zealand, Fiji, Cape of Good Hope, Natal, Transvaal, Orange River Colony, Rhodesia, Nyasaland, St. Helena, Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, British East Africa, Zanzibar and Pemba, Uganda, Somaliland, the Anglo-Egyptian Sudan, Malta, Cyprus, Ceylon, Hongkong, Mauritius, Seychelles, Straits Settlements, the Federated Malay States, and India.

Special arrangements are made for the conduct of schools and institutions desirous of visiting the Colonial and Indian Collections for educational purposes.

A stand has been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Pamphlets, circulars, handbooks, &c., containing information relating to the commerce, agriculture, mining, and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. The principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the departments in the main building.

The Scientific and Technical Department.—The research laboratories of this department, which occupy the second floor of the Imperial Institute, were established in order to provide for the investigation of new or little-known natural products from the Colonies and India, and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade, and industries of the Colonies and India.

The work of this department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have also been made by the Foreign Office, whereby British representatives abroad may transmit to the department for investigation such natural products of the countries in which they are appointed to reside as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the department, and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

Except under special circumstances, investigations are not undertaken for private individuals.

A Reference Sample Room is maintained in this department in which are arranged samples of the principal materials which have

been investigated and valued commercially during recent years, and as to which full information is available.

The Scientific and Technical Department works in co-operation with the Agricultural, Forest and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations and enquiries as are of a special character, scientific or technical, connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial value of products (vegetable and mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

In 1903 a volume of "Technical Reports and Scientific Papers" was issued by the Imperial Institute, which included the principal reports on those subjects which had been investigated in the Scientific and Technical Department. This volume has been in considerable demand, and it has been decided to publish a selection of the reports which have been made since it was issued. The work of the Imperial Institute has, however, grown to such large dimensions in recent years that it is no longer possible to include in a single volume even a selection of the principal reports on the various subjects which have been investigated. The information is therefore being issued by the Colonial Office as a series of selected reports on the more important subjects. Two parts of the series have now been published in "Colonial Reports, Miscellaneous," Part I., Fibres (Cd. 4588, 1909 and Part II., Gums and Resins (Cd. 4971, 1909). Other parts are in course of preparation.

Mineral surveys, under the supervision of the Director of the Imperial Institute and conducted by surveyors selected by him, have been in progress in Ceylon, Northern Nigeria, Southern Nigeria and Nyasaland. Preliminary arrangements of a similar nature have been made in connection with British East Africa and with the Anglo-Congolese Boundary Commission in Uganda. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained. Reports by the Director on the results of the mineral exploration in Northern Nigeria and Nyasaland have been printed during the year in the Miscellaneous Series of Colonial Reports.

In connection with the operations of the Agricultural Departments in West Africa, and with a view to correlating their work and that of the Imperial Institute, an Inspector of Agriculture for British West Africa (Mr. G. C. Dudgeon) has been appointed, who visits West Africa each year, and on his return has his headquarters at the Imperial Institute.

African Tropical Service Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction in the subject of tropical cultivation and products in this course is given by members of the staff of the Imperial Institute.

Library and Reading-Rooms.—The Library and reading-rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference, and are regularly supplied with the more important official publications, and with many of the principal newspapers and periodicals of the United Kingdom, the Colonies, and India.

The library and reading-rooms are on the principal floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute, and of other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownagree corridor and rooms in connection with this hall belong to the Indian Section of the Imperial Institute, whilst the hall is available for lectures, meetings, &c.

The *Bulletin of the Imperial Institute* is published quarterly, price one shilling (annual subscription 4*s.* 8*d.*, including postage), and may be purchased at the Imperial Institute or from Messrs. Eyre and Spottiswoode, Ltd., East Harding Street, Fleet Street, London, E.C., or from agents in the Colonies and India. The *Bulletin* contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (vegetable and mineral).

The following societies have their headquarters at the Imperial Institute:—

British Women's Emigration Association. — The British Women's Emigration Association has been assigned an office on the first floor, which is open daily from 10 a.m. to 4 p.m., and advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge. This Association works in co-operation with the Emigrants Information Office in Westminster.

Colonial Nursing Association.—This Association has been assigned an office on the first floor of the Imperial Institute. Its principal object is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependencies.

African Society.—This Society, which is concerned with the consideration and discussion of subjects connected with the British African Possessions, has been assigned an office on the mezzanine floor, and holds meetings for the discussion of African questions. The *Journal of the African Society* is published quarterly.

The Imperial Co-operation League.—This League has been assigned an office on the mezzanine floor. The object of the League, which is non-political, is to promote the closer union of

the Empire, more particularly in regard to co-operaion between the United Kingdom and the Self-Governing Dominions in matters of defence and Imperial policy.

II.—GENERAL.

The present report relates to the work which has been carried out in the several Departments of the Imperial Institute during the year 1909, and is in continuation of previous Reports (Cd. 3729-48, 1908, and Cd. 4448-10, 1909). It will be seen that the work of the Institute has further increased in amount and usefulness in all Depatrments.

The Exhibition Galleries, in which improvements have been continuously carried on, have received many important additions during the year, especially from the Crown Colonies and Protectorates. The number of visitors again shows an increase on the preceding year, and a number of schools have made special arrangements for visits under the guidance of members of the Staff.

In connection with the increasing use of the Exhibition Galleries for educational purposes, and especially in the teaching of the commercial geography of the British Empire, it is necessary to point out that the ground to be covered is so large that it is desirable for schools to devote several visits, the different sections of the Galleries being taken in turn, and to make arrangements for members of the Staff to explain the leading features of each section to the teachers prior to the visits of the pupils. Experience shows that by working on these lines the educational value of the visits to the Exhibition Galleries is greatly increased. In the case of country schools loan collections of the commercial products of the Colonies and India have been prepared to assist the further teaching. The Victoria League, which has taken special interest in this work, has arranged for the circulation of certain of these collections in country schools, which are in connection with branches of the League.

The work accomplished by the Scientific and Technical Department, which is described in considerable detail in the following pages, has included investigations in connection with a large variety of products. In addition to the actual investigation of new products a large number of enquiries from merchants, manufacturers and others have been answered on subjects which have already been investigated at the Imperial Institute or as to which special information has been collected. In this way a great deal of information is disseminated to the commercial community, leading to the practical development and utilisation of the products and resources of the British Dominions.

The official correspondence, exclusive of circulars, &c., during the year amounted to 5,200 letters received and 8,132 letters despatched, compared with 4,693 received during the year 1908, and 7,218 despatched. The 8,132 letters despatched included 447 reports on the results of scientific and technical enquiries and investigations connected with tropical agriculture and the utilisation of raw materials.

As indicated in the previous report the need for further accommodation for the increasing work of the Imperial Institute is now becoming an urgent matter, the portion of the Building reserved for the purpose under the arrangement made with the Government in 1900 being no longer adequate.

III.—STAFF.

During the year 1909 the principal members of the staff were as follows:—

Director of the Imperial Institute:—
Wyndham R. Dunstan, M.A., LL.D., F.R.S.

Director's Office.

Secretary to the Director:—
J. H. Preston, M.A. (Oxon.), (until February, 1909).
Major E. J. Lugard, D.S.O.

Assistant Secretary to the Director:—
J. J. K. Greenway, B.A. (Cantab.).

Scientific and Technical Department.

Superintendent of Laboratories:—
T. A. Henry, D.Sc. (Lond.), F.C.S.

Technical Superintendent:—
H. Brown.

Principal Assistant:—
E. Goulding, D.Sc. (Lond.), F.C.S.

Special Assistants:—
H. H. Robinson, M.A. (Oxon.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.C.S.
B. E. Long, B.A. (Cantab.).

Senior Assistants:—
G. S. Blake, B.Sc. (Lond.), A.R.S.M., F.C.S. (until March, 1909).
T. Crook, A.R.C.S.I., F.G.S.
A. E. Andrews.
S. J. Johnstone.
R. G. Pelly, A.I.C.
S. J. M. Auld, Ph.D. (Würzburg), D.Sc. (Lond.).
F. W. Barwick (Mercers' Company's Research Fellow).
S. S. Pickles, D.Sc. (Vict.).

Assistants:—
H. E. Watt, D.Sc. (Dunelm), (until August, 1909).
J. R. Hill, B.A. (Cantab.).
W. O. R. Wynn.
V. M. Weil, B.Sc. (Lond.).
N. C. Akers, A.I.C.
G. M. Davies.
O. D. Roberts.
J. Shelton.
L. Wilson, B.Sc. (Lond.).
B. W. Whitfeild.

The special officers of the Mineral Surveys of Ceylon, Southern Nigeria, Northern Nigeria, and Nyasaland, which have been in progress under the supervision of the Director of the Imperial Institute, and of the preliminary surveys undertaken in British East Africa and Uganda, were:—

Ceylon:—
J. A. Daniel, B.A. (Cantab.) (Acting).

Southern Nigeria:—
A. E. Kitson, B.A. (Melbourne), F.G.S.
E. O. Thiele, B.Sc. (Melbourne).

Northern Nigeria:—
J. D. Falconer, M.A., D.Sc. (Edin.), F.G.S. (until July, 1909).
A. Longbottom, B.A. (Cantab.), (until July, 1909).

Nyasaland:—
A. R. Andrew, M.Sc. (Birm.), B.Sc. (N.Z.), F.G.S. (until May, 1909).
T. E. G. Bailey, B.A. (Cantab.), (until May, 1909).

EXHIBITION GALLERIES.—COLONIAL AND INDIAN COLLECTIONS.

Technical Superintendents:—
W. G. Freeman, B.Sc. (Lond.), F.L.S.
C. H. Nicholls, B.A. (Oxon.), F.L.S. (until September, 1909).
S. E. Chandler, D.Sc. (Lond.), F.L.S.
H. Spooner.
A. B. Jackson.

AFRICAN TROPICAL SERVICE COURSE.

Instructors in Tropical Cultivation:—
W. G. Freeman, B.Sc. (Lond.), F.L.S.
S. E. Chandler, D.Sc. (Lond.), F.L.S.

Instructors in Tropical Products:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
H. Brown.
E. Goulding, D.Sc. (Lond.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
R. G. Pelly, A.I.C.
F. W. Barwick.

IV.—PUBLIC EXHIBITION GALLERIES.

The principal aim of the Colonial and Indian Collection is, by means of exhibits chiefly consisting of raw materials and primary manufactures, to illustrate the commercial and industrial resources of the various parts of the British Empire and to present a view of their economic position.

In the early part of 1909 much time was occupied in the incorporation in the different Courts of the exhibits which were transferred to the Inperial Institute by the Colonies and India from

the Franco-British Exhibition in 1908. Fresh exhibits have also been received from Canada, the West Indies, Falkland Islands, East and West Africa, Natal, Transvaal, Rhodesia, Sudan, Mauritius, Seychelles, India, Ceylon, the Strait Settlements, and Federated Malay States, and Hongkong. Reports on the present condition and requirements of certain Courts have been forwarded to the Colonial Governments concerned, and suggestions for the formation of a Papua Court have been drawn up for the Government of the Australian Commonwealth.

The rearrangement of the East Gallery containing Indian exhibits, and of the Indian Pavilion, following upon their redecoration, has been practically completed, a conspicuous feature among the exhibits being a Collection of Royal Presents and Addresses lent by His Majesty the King. The redecoration of the North Gallery has also been carried out.

Considerable improvements have been effected in the Sudan Court. Three large show-cases and a special timber stand have been provided, and a large-scale map prepared and hung. The arrangement of the numerous exhibits received is in progress.

An addition of considerable importance has been made in the Upper East Gallery, where a Reference Collection of the principal Standard Commercial Products has been established, in order to facilitate comparison with new products received from the Colonies.

A number of visits to the Exhibition Galleries have been paid by schools, many of which were conducted through the galleries by the Technical Superintendents of the Colonial and Indian Collections, who furnish information regarding the exhibits and the countries whose resources they illustrate. Specimens of Colonial products have been supplied to many schools for purposes of teaching the commercial geography of the British Empire, whilst three Loan Collections, consisting of the products of Canada, South Africa, and Australia, respectively, have at the instance of the Victoria League been prepared for circulation among educational institutions.

The number of visitors to the Exhibition Galleries during 1909 was 162,802, as compared with 110,189 during the preceding year, and 10,936 publications relating to the Colonies and India were distributed from the Central Stand. Many verbal enquiries regarding emigration and tropical agriculture were answered by the Technical Staff.

The Indian and Australian Stores have been re-organised and a considerable improvement effected, but the need for further storage accommodation increases and in the near future further space for exhibition purposes will be needed.

V.—THE LIBRARY.

Lists of the chief works exclusive of official publications which have been added to the Library in the course of the year have appeared in the *Bulletin of the Imperial Institute*.

In the Library, as in other departments of the Institute, room for expansion is much needed.

In addition to its use by the staff and by Life Fellows of the Imperial Institute, the Library has been available for enquirers for special information and other visitors who are duly introduced.

VI.—"BULLETIN OF THE IMPERIAL INSTITUTE" AND OTHER PUBLICATIONS.

Bulletin of the Imperial Institute.

The *Bulletin* has now a considerable circulation in the Colonies and India. Many firms of British and Colonial merchants and manufacturers were added to the list of subscribers during the year, and the publication attained a circulation of over 7,000 copies.

The following are the titles of the articles which have appeared in the quarterly numbers of the *Bulletin*, Vol. VII. (1909):

Reports on Investigations:—

Rubber of *Sapium Jenmani* from British Guiana.
Balata from British Guiana.
Fibres from India.
Cotton from the Gold Coast.
Timbers from the Sudan.
Some African Food Grains.
Cotton from Southern and Northern Nigeria.
Sisal Hemp from the East Africa, Uganda, and Nyasaland Protectorates.
Mauritius Hemp and "Likanga" fibre from Nyasaland.
Rubber from Southern India.
Recent discoveries of Graphite in British African Colonies.
Rubbers from Southern Nigeria.
Rubber of *Ficus Vogelii* from the Gambia.
"Vahea" Rubber from Seychelles.
Goats' Hair and Mohair from Uganda.
Tobaccos from Nyasaland.
"Ebony" from the East Africa Protectorate.
Economic Products from Fiji.
Chromite Ore from the Transvaal.
Laterites from the Central Provinces of India.
Investigations in connection with the African Palm Oil Industry.

Special Articles:—

The Agricultural Resources of Nyasaland.
Indian Lac Industry.
Utilisation of Waste Wood.
Preparation of Mica Powder.
Papua and its Economic Resources.
Occurrence and Utilisation of Tungsten Ores.
Peppermint Oil.
The Tussur Silkworm in India.

Cocoa Cultivation in German Colonies.
Iron Ores of the Crown Colonies and Protectorates of the British Empire.
Cultivation and Utilisation of the Soy Bean.
Agricultural Work in Nyasaland.
Recent Developments in the Seychelles.
Vanadium; its Occurrence, Preparation and Uses.

General Notes:—

Rubber Cultivation in Malaya.
Cotton Ordinances of the Uganda and East Africa Protectorates.
Senecio latifolius from Cape Colony.
The Constituents of East Indian Satinwood.
Sponges from Bermuda.
Soy Beans.
Utilisation of Para Rubber Seed.
New Series of Selected Reports from the Imperial In tute.
Report on the Work of the Imperial Institute, 1908.
Para Rubber in Southern Nigeria.
Silk Industry of Ceylon.
Agricultural Experiments in Portuguese East Africa.
Sansevieria Tow from Sierra Leone.
Sansevieria Fibre from the Sudan.
Synthetic Rubber.
Agricultural Show in Southern Nigeria.
Indigo from Nigeria.
Ylang-ylang Oil in the Philippines.
The Pearl Fisheries of Mergui, Burma.
Carnotite from South Australia.
Mineral Survey of Nyasaland.
Mineral Survey of Northern Nigeria.
International Congress of Tropical Agriculture and Colonial Development.
Vegetable Waxes from Mexico.

Other Publications.

During the year the following publications have also been issued:—

Colonial Reports, Annual, No. 601. Report on the Work of the Imperial Institute, 1908. (Cd 4448-10.)
Colonial Reports, Miscellaneous, No. 58. Selected Reports from the Scientific and Technical Department of the Imperial Institute. Edited by the Director. I., Fibres. (Cd. 4588.)
Colonial Reports, Miscellaneous, No. 63. Selected Reports from the Scientific and Technical Department of the Imperial Institute. Edited by the Director. II., Gums and Resins. (Cd. 4971.)
Report on the Results of the Mineral Survey of Northern Nigeria, 1906-07, No. IV. of Series. By Professor Dunstan. (Cd. 4719.)
Report on the Results of the Mineral Survey of Nyasaland, 1907-08, No. II. of Series. By Professor Dunstan. (Cd. 4908.)

The following is a list of the principal papers contributed to scientific and technical Journals by members of the scientific staff of the Imperial Institute:—

"The Systematic Examination of a thin section of a Crystal with an Ordinary Petrological Microscope." By Dr. J. W. Evans. (Proceedings of the Geologists' Association, Vol. 21, 1909, pp. 79-94.)

"The Rocks and Minerals of our African Colonies and Protectorates." By Dr. J. W. Evans. (*Ibid.*, pp. 153-156.)

"The Genesis of Igneous Rocks." By Dr. J. W. Evans. (Science Progress, 4, 1909, pp. 306-320.)

"Chrysolite, Chrysotile, and Karystiolite." By Dr. J. W. Evans. (Geological Magazine, 1909, VI., No. 540, 286.)

"The Electrostatic Separation of Minerals." By T. Crook, (Mineralogical Magazine, 1909, XV., No. 70, 260.)

"Note on the Shore Sand of St. Ives Bay, Cornwall." By T. Crook and G. M. Davies. (Geological Magazine, 1909, VI., No. 537, 120.)

"The use of the term Laterite." By T. Crook. (Geological Magazine, 1909, VI., No. 545, 524.)

"Optical Peculiarities in Phlogopite." By T. Crook. (Geological Magazine, 1909, VI., No. 545, 512.)

"Recent Research on Indigo." By H. H. Robinson. (Science Progress, 1909, 4, 575.)

"The Hydrolysis of Amygdalin by Emulsin, Part III., Synthesis of d-benzaldehydecyanohydrin." By Dr. S. J. M. Auld. (Journal of the Chemical Society, 1909, 95, 927.)

"An Examination of Irritant Woods, Part I., Chloroxylonine from East Indian Satinwood." By Dr. S. J. M. Auld. (Journal of the Chemical Society, 1909, 95, 964.)

"An Extraction Apparatus for Plant Products." By Dr. S. J. M. Auld and Dr. S. S. Pickles. (Chemical News, 1909, 99, 242.)

VII.—SCIENTIFIC AND TECHNICAL DEPARTMENT.

A detailed account will be found in the succeeding pages of the work carried on in this Department during the year, partly in conducting investigations as to the composition and value of raw materials, mineral and vegetable, and partly in supplying information respecting the utilisation of such materials, and also their cultivation and production. The number of investigations and enquiries requested in 1909 was 521, 447 reports were completed, and at the end of the year 246 investigations were in progress. Details respecting these investigations are given under the headings of the subjects to which they relate. The countries for which investigations have been conducted are:—

Bahamas, Bermuda, British Honduras, British North Borneo, British Guiana, Canada, Cape of Good Hope, Ceylon,

Cyprus, Dominica, East Africa Protectorate, Falkland Islands, Federated Malay States and Straits Settlements, Fiji, Gambia, Gold Coast, Hongkong, India, Jamaica, Mauritius, Natal, Newfoundland, New Zealand, Northern Nigeria, Nyasaland, Orange River Colony, Queensland, Rhodesia, St. Helena, Seychelles, Sierra Leone, Southern Nigeria, Sudan, Tasmania, Transvaal, Uganda, Victoria, Wei-hai-wei, Western Australia, and Zanzibar.

It will be seen that the operations of this Department during the year show again an increasing amount of important work accomplished for the Colonies and India, as well as directly or indirectly for the United Kingdom. Merchants and manufacturers in increasing numbers have shown themselves anxious to obtain full information respecting products from British Possessions suitable for manufacturing purposes, and have rendered the Department considerable service in supplying information as to the commercial prospects of materials which investigation in the Department has shown may possess commercial value. In addition to this, each year direct enquiries from manufacturers in this country as to the sources and composition of raw materials increase in number, and the Department is more and more becoming a sort of clearing house for information respecting the possibilities of the raw materials of the Empire for manufacturing purposes.

In connection with the explorations conducted in the Colonies by and through the Department for materials of commercial value, it will be seen that the Mineral Surveys, referred to in detail in the Reports for 1906-7 and for 1908, have been continued, and that through them much important information has been obtained. In Southern Nigeria particular attention has been directed to the exploration of the lignite deposits which seem likely to prove of considerable service as a source of fuel in West Africa, and the material received has been submitted to very complete examination in the Department.

The subject of cotton and fibres has again proved to be an important section of work, and a large number of specimens which have been examined and reported on have been added to the Reference Collections.

In the subject of rubber, particular attention has been paid to the examination of rubber from new sources and also to improvements in the collection and preparation of African wild rubber.

The subjects investigated during the year included Minerals, Cotton and other fibres, Rubber, Timbers, Oils and Oil Seeds, Volatile Oils, Food Grains and Feeding Stuffs, Tanning Materials, Gums and Resins, Dyestuffs, Drugs and Tobacco.

Minerals.

Countries of Origin.—Ceylon, Southern Nigeria, Northern Nigeria, Nyasaland, Uganda, East Africa Protectorate, Cyprus, Rhodesia, Transvaal, Orange River Colony, Natal, Cape Colony, India, Straits Settlement, and Federated Malay States, Australia, Fiji, Falkland Islands, West Indies, Canada, United Kingdom.

Mineral Surveys.

The Mineral Surveys in Ceylon, Southern Nigeria and Nyasaland were continued, and in connection with these over 3,000 specimens of minerals were received for investigation. The work of the Geologist accompanying the Anglo-Congolese Boundary Commission was concluded, and several special investigations were undertaken by him in Uganda and the East Africa Protectorate. The rocks and minerals collected in the course of this work were received for examination during the year.

Ceylon.—The minerals under investigation from Ceylon in connection with the Mineral Survey included crystalline quartz, molybdenite, limestones, mineral waters; rare earth minerals, such as thorianite, thorite, monazite, zirkelite and fergusonite, and a long series of concentrates prepared by washing river sands and gravels, &c.

Southern Nigeria.—The minerals received in connection with the Mineral Survey of this Colony in 1906-07 were reported on, and the report has been issued in the Miscellaneous Series of Colonial Office Reports (Cd. 4995). The area surveyed during this period may be described as follows:—

(1.) A circuit of about 20 miles from Okpenam, through Ibusa, Ogwashi-Osaba, Ekudiogo, and Issele-Azaba, and back to Okpenam.

(2.) From Okpenam through Illa, Obrubru, Ukpai, Ubiaja, Afuda, Agbede, and back to Okpenam viâ Ubobiggon, Igaw, Issa and Issele.

(3.) The lignite area near Moroko.

Special and detailed attention has been given to the investigation of the deposits of lignite with a view to their utilisation.

The Minerals collected during these tours belong to several groups:—

Concentrates.—These were collected chiefly from the beds of the Atakpo River and its tributaries. They all carried small quantities of monazite. Many of them also contained gold, and a few showed traces of tinstone. The amounts of monazite and tinstone present were in all cases too small to make the concentrates of commercial value, but in a few specimens the amount of gold was sufficient to indicate that sluicing of these river sands might repay native working.

Lignites.—Sixty samples were examined from the deposits in the areas explored. They were of good quality as a whole and quite suitable for use as fuel and for the production of gas. They varied in composition at different parts of the deposits, and consequently care will need to be exercised in working the beds. It was observed that most of these lignites showed a tendency to disintegrate when stacked. This is a common experience with lignite, and can be remedied as a rule by briquetting. Trial consignments of lignites from the principal deposits were obtained by the Imperial Institute during 1909, and these will be used for briquetting trials.

Clays.—These were mostly bedded clays occurring in association with the lignites referred to in the preceding paragraph. They were mostly of light grey colour, free from grit, and soft

and unctuous in texture. They disintegrated quite readily in water, forming plastic materials which could be worked readily on the wheel. The amount of iron oxide present was usually from 1·5 to 2·5 per cent., but a few of the clays were deeply coloured.

Several of the clays were analysed completely in order to establish their identity and assist in their classification. All the samples were submitted to pottery trials, and their behaviour on firing with various glazes was tested. Many of them proved to be suitable for the manufacture of pottery, and one or two of them might be used for the preparation of fire-bricks. These clays are of special interest in view of the fact that in many tropical countries attempts are now being made to improve native methods of pottery manufacture. Action on similar lines in Southern Nigeria seems likely to be successful.

Among miscellaneous minerals reported on for Southern Nigeria during 1908-09 were numerous samples of borings obtained in the course of prospecting work for petroleum, now being carried on in the Colony, and a further series of these was under investigation at the end of the year, in addition to ores of lead and zinc.

Northern Nigeria.—The minerals collected during the year 1907-08 and part of those obtained in 1908-09 were reported on. The following is a summary of the chief results of economic importance obtained.

Iron Ores.—These were collected mainly from the iron ore deposits of the Kabba District. They belong to two classes, viz., (1) fairly rich limonites (hydrated ferric oxide), containing on an average the equivalent of about 50 per cent. of metallic iron, and (2) siliceous magnetites, generally containing the equivalent of 40 to 50 per cent. of metallic iron. All these iron ores are used more or less by the natives of the districts in which they occur for smelting by primitive methods, but the limonites are for the most part too rich in phosphorus and the magnetites too siliceous to be worth exporting under present conditions. These Kabba deposits will, however, prove a valuable asset to the Protectorate in the future.

A series of fifteen limonitic iron ores from the deposits on Mount Patti, near Lokoja, was collected in 1908-09. These on examination proved to include some iron ores of very good quality, though some of them were rather high in phosphorus or titanium. Samples of these ores were submitted, with analyses, to iron-masters in this country, and one or two of them were considered likely to be suitable for export. These deposits are of immense extent, and are favourably situated for export. It is probable that they would yield on the average iron ore containing the equivalent of 50 per cent. of metallic iron.

Limestones.—Several samples of good limestones were collected between Jakura and Wa, where a deposit of white crystalline limestone 1,000 feet thick was found. One of these on analysis proved to contain 95 per cent. of calcium carbonate, and to yield on burning " fat " lime suitable for agricultural purposes and for making mortar.

Two samples of argillaceous limestone might be suitable for preparing hydraulic cement, and a consignment has been asked for, for technical trial.

Concentrates.—These were collected from steam gravels in Kabba Province. They mostly contained monazite and tinstone, but were not very promising from an economic point of view, the quantities of these minerals present being usually small. Two concentrates from the Bauchi area, however, contained 6·75 and 35·5 per cent. of tinstone.

Tinstone.—During the work of the Survey in 1908-09, considerable quantities of coarse pegmatite carrying tinstone were discovered in the Eri district. A sample of this material examined at the Imperial Institute yielded 20·5 per cent. of tinstone. An analysis of the latter showed it to contain the equivalent of 73·2 per cent. of metallic tin. This pegmatite could be easily worked for the tinstone it contains.

Miscellaneous.—These included "salts" made by natives in the Bornu Province. They were all crude mixtures of sodium sulphate with more or less sodium carbonate and sodium chloride.

A report on the work done by the Survey in 1907-08 was published during the year in the Miscellaneous Series of Colonial Reports (Cd. 4719).

At the close of the year a report was in preparation on the remainder of the minerals collected in 1908-09, and several mineral samples forwarded by political officers in Northern Nigeria were also under investigation.

Nyasaland.—The investigation of the minerals collected by the officers of the Survey in 1907-08 was completed, and the report was published in the Miscellaneous Series of Colonial Reports (Cd. 4908). The chief results of economic interest obtained were as follows:—

Coal.—The deposits in North Nyasaland were fully examined and representative samples collected in the principal areas. These were analysed, and the results are given in detail in the report already referred to.

The coals all belonged to the bituminous class, though some of them approached brown coal in appearance and composition. The best samples were obtained from the Mount Waller area, and the poorest from the Lufira area. The Kasante, Nkana and Rukura districts yielded coals of intermediate quality.

Limestone.—The limestones received were examined in detail with a view to ascertaining whether any of them yielded hydraulic lime, or could be used for cement making. The results of thes trials were very promising, and further supplies have been asked for so that large scale trials may be made. Many of the limestones were free from silica and clay, and would be suitable for making lime for common mortar and for agricultural purposes, or could be used for cement manufacture in conjunction with clay.

Concentrates.—A large number of concentrates prepared from stream gravels were examined. These were usually black sands with ilmenite and magnetite as the principal constituents. Monazite was usually present in very small amount. Gold was found in a few of the concentrates obtained from the beds of cer-

tain tributaries of the Lisungwe, but the occurrence is small and not worth working since there appears to be no general distribution of gold in the gravel.

Miscellaneous.—These included argentiferous galena from Lilongwe, which proved to be of good quality and rich in silver, mica, cement-making materials, strontianite, &c. The most interesting mineral in this group was a sample of flake graphite of fine quality from Mkoma in Central Angoniland. A firm in the United Kingdom to whom a portion of this material was submitted by the Imperial Institute has despatched a representative to investigate the occurrence with a view to working it if it proves large enough.

At the close of the year a report was in preparation on the results of examination of the minerals collected by the Surveyors in 1908-09.

Anglo-Congolese Boundary Commission.—At the close of his work in connection with the Anglo-Congolese Boundary Survey, the Geologist appointed to accompany the Commission was deputed to examine certain areas in Uganda and the East Africa Protectorate, and the minerals then collected were examined and a report on them was in preparation at the end of the year.

East Africa Protectorate.—A number of minerals collected by the Mining Expert to the Government were reported on. These included copper ores, auriferous quartz, mica, and manganese ores. The gold-bearing quartz yielded rather more than 1½ oz. of gold per ton. The manganese ores were of promising quality; one contained 66·9 per cent. of manganese dioxide and 4·75 per cent. of manganous oxide, and another 66·2 and 5·61 per cent. of these oxides respectively. Ores of this quality would be suitable for export to the United Kingdom.

A sample of diatomite of fine quality and a specimen of sulphur were also received. At the close of the year a number of gold-bearing concentrates and also a series of rocks, alkali salts, and waters from Lake Magadi were under examination.

Cyprus.—A sample of magnesite contained 95·5 per cent. of magnesium carbonate, and was valued at 30*s.* per ton. A number of promising samples of asbestos were received, and larger samples of these were asked for for valuation and trial. Kaolin, natural copper sulphate and other products were under examination at the close of the year.

East Africa Protectorate.—In addition to the minerals referred to above under Surveys, a number of samples of soil, quartz, &c., were received for examination.

Uganda Protectorate.—In addition to the minerals referred to under Surveys, as received from Uganda for examination, a number of other rocks and minerals were received from the Protectorate.

These included saline spring waters, native prepared salts, an oily bitumen, clays, gypsum, cement-making materials, calcareous nodules, and various minerals for identification.

Rhodesia.—Three samples of auriferous quartz and pyrites contained respectively 2 grains, 1·8 grains, and 5·5 grains of gold per ton. A manganese ore containing 14·3 per cent. of manganese

dioxide and 4·36 per cent. of manganous oxide was also reported on. At the end of the year a series of quartz samples from the Sassare reef, some of them very rich in gold, were under examination.

Transvaal.—Two samples of chromite contained 47·0 and 38·4 per cent. of chromium sesquioxide respectively; the first of these would be suitable for export. A number of special enquiries were carried out for this Colony; these included the following subjects: the electric smelting of iron and steel, the manufacture and use of calcium sulphate to be used as a filling material, and the utilisation of hydrated magnetic iron oxide. At the end of the year arsenical tin ore and other samples were under investigation.

Orange River Colony.—Samples of sodium sulphate obtained as a by-product in salt manufacture were under examination.

Natal.—Samples of graphite, asbestos, and iron ore were examined. The asbestos proved to be of marketable quality, and one of the graphites would be saleable in the United Kingdom at a low price.

Cape Colony.—Samples of supposed graphite proved to be merely graphitic shale of no value. Information was supplied regarding the present value of tungsten, tantalum, and molybdenite. A sample of tin ore was found to contain 82·5 per cent. of tinstone and no wolfram. A number of mineral samples were also identified for commercial firms in the Colony.

India.—The materials received for examination included a tungsten ore from Burma, corundum from Southern India, kaolin, limestone and marl from the Central Provinces, lignite, monazite sands, molybdenite and pyrrhotite from Travancore, graphites from Madras, &c. The tungsten ore, molybdenite, pyrrhotite and monazite sands were all of considerable economic value, and the kaolin proved to be suitable under certain conditions for the manufacture of pottery. The graphites were all of poor quality.

Straits Settlements and Federated Malay States.—Analyses were made of four mixed tinstone concentrates from Kelantan. These contained 18·4, 16·5, 85·8 and 72·5 per cent. of tinstone respectively, and Nos. 2, 3 and 4 were also rich in gold and silver, whilst No. 2 contained 2·10 per cent. of thoria. Specimens of "amang" and of an unidentified mineral were under investigation at the close of the year.

Australian Commonwealth.—A sample of corundum containing 84·0 per cent. of alumina and of good quality as an abrasive was received from Victoria. A number of samples of monazite sand from New South Wales were analysed and valued. Asbestos and tantalite were received from Western Australia; the former proved to be of no economic value, but trials are being made with the tantalite for the production of tantalum steel. A number of graphites were received from Queensland, but proved to be of small value.

Fiji.—A promising copper ore was received and examined. It contained 40·3 per cent. of copper and yielded 2 oz. 16 dwt. of

gold and 3 oz. 11 dwt. of silver per ton, and was valued at approximately £30 per ton.

Falkland Islands.—Samples of pyrites were received and examined, and at the end of the year samples of bitumen of promising quality were under examination.

West Indies.—The most interesting samples received were a very pure salt from Turks Island, containing 99·4 per cent. of pure sodium chloride, and a number of specimens of natural and prepared asphalt from Trinidad.

Canada.—Samples of alunite were received from British Columbia, and a number of enquiries regarding the market in this country for various Canadian minerals were dealt with.

Other Countries.—A specimen of auriferous banket was received from the Gold Coast Colony for examination. From firms in the United Kingdom a large number of minerals were submitted in the course of the year for identification, and in a few cases where the minerals were of Colonial or Indian origin analyses were made and valuations supplied on the basis of these results. A large number of mineral specimens were also sent for examination by British Consuls, especially from Turkey and Morocco, and in some cases the minerals received were of considerable economic interest.

Fibres (Including Cotton).

Countries of Origin.—Cyprus, Sudan, East Africa Protectorate, Uganda, Nyasaland, Rhodesia, Natal, Transvaal, Cape of Good Hope, Gold Coast, Sierra Leone, Southern Nigeria, Northern Nigeria, St. Helena, India, Ceylon, Borneo, British Honduras, British Guiana, Australia, Fiji, Mozambique and Erythraea.

Cotton.

Sudan.—Seven samples were examined and found to be of good saleable quality. Three were grown in Berber Province, and comprised Nubari, worth 9½*d.* per lb., with "fully good fair" brown Egyptian at 9 5-16*d.* per lb.; Abassi, worth 9*d.* per lb., with "good" Abassi at 9½*d.* per lb., and Gallini worth 10*d.* per lb., with "fancy" Florida Sea Island at 12*d.* per lb. Three further samples, consisting of Yannovitch, Mitafifi and Abassi varieties, were worth ¼*d.* to ⅜*d.* per lb. less than standard samples of similar varieties grown in Egypt. A sample from Monagil was of Egyptian character and worth about 10*d.* per lb., with "good" Abassi at 12⅜*d.* per lb.

East Africa Protectorate.—Two samples of cotton of "improved" Upland varieties, namely "Sunflower" and "Allen's Improved," were of excellent quality, and were valued at about 2*d.* per lb. in advance of "middling" American.

Nyasaland.—Three samples of cotton and one sample of cotton seed were examined. One sample of Egyptian cotton was regarded as being unsaleable, but the remaining samples, which were of American Upland type, were of excellent quality, and worth about 9*d.* per lb., with "middling" American at 7·72*d.* per lb. The seeds appeared to be of Upland type.

Uganda.—Twenty samples were of "improved" Upland type; they were of very promising quality and worth from 5·30*d.* to 6·00*d.* per lb., with "middling" American at 5·17*d.* per lb.

Five samples of American "Black Rattler" cotton were of good quality, but somewhat shorter than normal "Black Rattler" cotton. They were about equal in value to "middling" American.

Rhodesia.—One sample of brown Egyptian cotton was of excellent quality, and was sold at 8*d.* per lb., with "fully good fair" brown Egyptian at 7 15-16*d.* per lb.

Natal.—Three samples of Caravonica cotton were of fairly good quality and worth 8½*d.* to 9*d.* per lb., with "good" Abassi at 12⅜*d.* per lb., and "middling" American at 7·59*d.* per lb.

Cape Colony.—Two samples of American cotton, namely, "Allen's Improved" and "Sunflower" varieties, were of marketable quality, but somewhat stained. They were worth respectively 8·50*d.* to 8·75*d.* and 7·75*d.* per lb., with "middling" American at 6·75*d.* and "good" Abassi at 10½*d.* per lb. A sample grown near East London was soft and lustrous, but rather weak and somewhat stained. It was worth 9*d.* per lb., with "Middling" American at 7*d.* per lb.

British West Africa.—Three native varieties from the Gold Coast, including "Volta River" and "native green-seed," were of good quality and worth 4½*d.* to 5½*d.* per lb., with "middling" American at 5·05*d.* per lb. Another sample, grown near Axim, and probably a native variety, was rough, somewhat stained, and worth about 6*d.* per lb., with "middling" American at 5·54*d.* per lb. Twenty-three additional samples were placed in the reference collection.

A sample from Southern Nigeria was of rough character, similar to Peruvian, and worth about 7*d.* per lb., with "good" rough Peruvian at 7¾*d.* per lb. Samples of cotton seed and native made yarn were also examined.

Three samples from Northern Nigeria were examined. One was of rather rough character, similar to Peruvian, and worth about 6*d.* per lb., with "good fair" moderately rough Peruvian at 6·50*d.* per lb. A sample of native Nupe cotton from Baro was stained, of somewhat poor quality, and nominally worth 4½*d.* to 5*d.* per lb., with "middling" American at 6·55*d.* per lb. The third sample had been grown by natives in Munshi country, Nassarawa Province; it was of good quality but coarse and harsh, and worth 5⅞*d.* per lb., with "middling" American at 6·56*d.* per lb. A further sample was added to the reference collection.

Borneo.—A sample of cotton from Sarawak was similar in character to Peruvian, but somewhat stained, and worth 6·50*d.* per lb., with "good" rough Peruvian at 7·75*d.* per lb.

Erythraea.—Two samples of cotton of improved American type were found to be somewhat stained and worth respectively 8½*d.* to 9*d.* per lb., with "middling" American at 7·59*d.* per lb., and "good" Abassi at 12⅜ per lb.

Jute and Similar Fibres.

Sudan.—A sample of the fibre of *Hibiscus cannabinus* was badly prepared, and had evidently been collected from branched stems. Recommendations were made as to methods of improving the quality and value of the product.

Rhodesia.—A specimen of strappy, interlacing fibre, apparently derived from *Hibiscus* sp., or an allied plant, appeared to have been collected from plants of various ages, and was valued at £10-£11 per ton (with "common" jute at £12-£14 per ton). It was suggested that fibre of much better quality could be obtained from the younger plants.

Transvaal.—Samples of the fibres of *Hibiscus cannabinus* and *Triumfetta rhomboidea* were insufficiently retted, but in each case the product, if well prepared, would be of about the same value as "medium" jute.

British West Africa.—A specimen of "Barala" fibre (*Hibiscus Sabdariffa*) from Sierra Leone was of poor quality and worth about £14 per ton (with First Native Marks Calcutta jute at £13 10*s.* per ton).

A small consignment of "Kowe" (*Hibiscus quinquelobus*) and "Okra" (*H. esculentus*) fibres from Sierra Leone, consisting of several different qualities, was sold, but the prices realised were not encouraging. This was no doubt largely due to the small size of the consignment and its miscellaneous character, but the results indicated that the prospects of these fibres are not promising, and that it would probably be better to devote attention to jute.

A specimen of "Ramo" fibre from Southern Nigeria was not well prepared, and was worth about £10 per ton, although if the root-ends had been cut off its value would have been increased by about 20*s.* or 30*s.* per ton.

India.—Ten samples of jute, two of Bimlipatam jute, and one of each of the fibres of *Malachra capitata* and *Hibiscus Abelmoschus* were examined. The jutes were, on the whole, of good quality and valued at from £10 to £16 per ton (with First Native Marks at £15 per ton). The Bimlipatam jutes were regarded as worth £13 10*s.* and £14 10*s.* per ton. The *Malachra capitata* fibre was considered suitable as a jute substitute and worth £13 per ton. The *Hibiscus Abelmoschus* was too coarse for spinning with jute, but worth about £18 per ton for rope-making.

Fibres Suitable for Cordage Manufacture.

East Africa Protectorate.—A sample of well-cleaned Sisal hemp of good strength, but of short and irregular length, was valued at £23-£24 per ton (December, 1909).

Uganda.—Two samples of Sisal hemp were found to be of excellent quality and worth about £27 to £28 per ton (April, 1909).

Nyasaland.—A specimen of Sisal hemp, grown in the Government Gardens, Zomba, was of good colour, lustre, length and strength, and worth £24 per ton (January, 1909).

Four samples of Mauritius hemp of good quality, but rather towy, were valued at £19-£20 10*s.* per ton (March, 1909).

A very small specimen of "Likanga" fibre, probably derived from *Sansevieria* sp., was rather weak, but if a stronger product could be obtained it would probably be worth about £20-£25 per ton.

British West Africa.—A sample of *Sansevieria* fibre from Sierra Leone was weak and brittle owing to its having been prepared by boiling and retting.

A specimen of plantain fibre from Southern Nigeria was of good length but of uneven strength; it was regarded as suitable for mixing with Manila hemp, and worth about £20 per ton (January, 1909).

Samples of Pineapple and "Abala" (*Sansevieria* sp.) fibres from Northern Nigeria were of fair quality, and were regarded as worth £16-£17 and £22-£23 per ton respectively (November, 1909).

Mauritius.—Sisal hemp of excellent quality was examined and valued at about £30 per ton (September, 1909).

St. Helena.—A sample of the fibre of *Phormium tenax*, prepared from one-year-old leaves, was of good colour, but rather weaker than standard New Zealand hemp.

India.—A sample of Sunn hemp was found to be brittle and worth £17 to £18 per ton (November, 1909). Ten samples from Eastern Bengal and Assam were, on the whole, of very good quality, and were valued at from £17 to as much as £27 per ton (May, 1909).

A specimen of "Mooga" fibre (probably *Sansevieria* sp.) from Bengal was of good strength, but only 12-[illegible] inches long. The fibre was too short for rope-making, but if well prepared and about 3 feet long would probably find a market at about £28-£30 per ton.

British Guiana.—Two samples of "Crowa" fibre (*Ananas* or *Karratas* sp.?) were of good quality and worth £20 and £24 per ton respectively (October, 1909).

Western Australia.—A sample of fibre, probably derived from a species of *Agave* or *Sansevieria*, was clean and strong, but only 2-3 feet long. If obtainable of greater length it would probably realise about £30 per ton (December, 1909).

Fiji.—A sample of "American aloe" fibre was of excellent quality and length, and worth about £31 per ton (March, 1909).

Ramie.

British West Africa.—A sample of scraped ramie ribbons from Sierra Leone was of greenish-brown colour, normal strength, and 3-4 feet long. The product was clean and well prepared, and was regarded as worth about £14-£15 per ton (December, 1909).

Fiji.—Samples of ramie ribbons and fibre of very good quality were examined, and the former were considered to be of approximately the same value as hand-scraped China grass.

Flosses or Silk-Cottons.

Specimens of these products were received from Rhodesia, the Cape of Good Hope, Western Australia, and Florida. When sufficiently resilient they can be used as stuffing materials in upholstery, and are worth about 4*d.* or 5*d.* per lb.

Wool and Goats' Hair.

Cyprus.—A sample of goats' hair from Cyprus was of poor quality, and but little value.

Natal.—A specimen of wool from Persian sheep at the Cedara Experimental Farm was found to be a "carpet" wool of good

style and long staple, and readily saleable at 5*d.* to 5½*d.* per lb. (July, 1909).

Uganda.—A sample of straight, black, lustrous goats' hair, varying from 3 to 9 inches in length, was regarded as worth 4½*d.* to 4¾*d.* per lb. (December, 1908), the longer hairs being suitable for the manufacture of hair-cloth for upholstery and the shorter for curled hair for stuffing purposes. Two samples of yellowish-white goats' hair were valued at 4*d.* to 4½*d.* and 3¾*d.* to 4*d.* per lb. (May, 1909).

Three samples of mohair were received, two of which were of fair average quality and saleable at 9*d.* to 9½*d.* and 9½*d.* to 10*d.* per lb., whilst the third was shorter and coarser, and worth 6½*d.* to 7*d.* per lb. (June, 1909).

Silk.

Uganda.—In connection with the investigation of "wild silk" (*Anaphe* sp.), it has been established that the material could be used by silk-spinners if it were available in sufficient quantities and at a low enough price. The possibility of degumming the silk before export has been carefully studied. It is evident, however, that it would be better to export the silk, without previous degumming, either in the form of the crude nests or after removing the twigs and chrysalides. It is at present uncertain whether an industry in this product would prove remunerative.

British West Africa.—A specimen of cocoons from Northern Nigeria, which were found on a thorn-bush (*Zizyphus mucronata*, Willd.), was examined, but the silk was found to be so weak as to be useless for spinning, and therefore valueless.

Five examples of silk from Southern Nigeria, including nests of *Anaphe infracta* and *A. venata* and "Gambari" silk, which had been degummed by the natives, were added to the reference collection. A nest of cocoons which contained live pupae was kept at a suitable temperature until the moths emerged, when it was possible to identify the insect producing the nest as *A. infracta*.

Ceylon.—Two samples of silk fabrics made from "Eri" silk (*Attacus Ricini*) were coarse and unevenly woven, and not likely to find a demand in the United Kingdom.

Miscellaneous Fibres.

Various other fibrous materials were examined and reported on, among which may be mentioned:—The fibre of *Gomphocarpus* sp. from the Cape of Good Hope; Cryptolepis and palm fibres from Rhodesia; four fibres from Southern Nigeria, viz., "Ororhon" (*Triumfetta eriophlebia*), "Ogohon" (*Musanga Smithii*), "Obada" (near *Ficus Vogelii*), and "Orgor" (*Raphia longifera*); "Vacoa" leaves from Mauritius; *Melaleuca lanceolata* fibre from Burma; and areca nut husk fibre from Ceylon.

Numerous enquiries were dealt with relating to the cultivation, preparation, utilisation and exploitation of various fibres, requests for information being received from merchants and manufacturers in the United Kingdom as well as from planters and others in the Colonies.

Rubber.

Countries of Origin.—Straits Settlements, Sarawak, Seychelles, Gold Coast, Southern Nigeria, East Africa Protectorate, Uganda, Zanzibar, Nyasaland, Transvaal, Rhodesia, West Indies, and British Guiana.

Straits Settlements.—Two specimens of smoked Para rubber, prepared in the Singapore Botanical Gardens, by the Brazilian process, were received for examination. The rubber was moist and had a strong odour of creosote. The analysis of the samples gave the following percentage results:—

(1.) Moisture 9·0; caoutchouc 80·2; resin 4·7; proteids 5·3; ash 0·8 (caoutchouc 88·1 per cent. in dry rubber).

(2.) Moisture 8·8; caoutchouc 82·0; resin 4·7; proteids 3·4; ash 1·1 (caoutchouc 89·9 per cent. in dry rubber).

The percentage of resin is a little high in both specimens, and the amount of proteids in No. 1 is greater than is usually found in plantation rubber.

A small consignment of rubber, represented by these specimens, was sold in London at 7*s.* 6½*d.* per lb., with fine hard Para at 9*s.* per lb., and fine plantation Para at 9*s.* to 9*s.* 8½*d.* per lb.

Sarawak.—A sample of "Siria" rubber from Sarawak consisted of light-brown rubber having a somewhat musty odour. The dry material was found to contain 65·3 per cent. of caoutchouc and 31·1 per cent. of resin, and it was inferior in physical properties. The name of the plant yielding this rubber is not at present known.

Seychelles.—Two samples of Para rubber, stated to be from trees four to six years old growing in Seychelles, were found to be of satisfactory composition but deficient in physical properties. This defect will, however, probably disappear as the trees become older. The samples contained 93·1 and 93·8 per cent. of caoutchouc respectively, calculated on the dry material, and were valued at 6*s.* per lb., with fine hard Para at 8*s.* 6*d.* per lb.

The results of the examination were distinctly promising, and it appears probable that Para rubber of good quality can be successfully produced in Seychelles.

Gold Coast.—Two samples of Funtumia rubber from this Colony were examined. The latex was stated to have been coagulated by the juice of the "Diecha" vine, which has since been identified at Kew as *Strophanthus Preussii*, Engl. et Pax. The action of this coagulant is still under investigation at the Imperial Institute.

The samples consisted of a piece of crêpe rubber, and two large cakes of lump rubber. The dry crêpe rubber contained 83·2 per cent. of caoutchouc, 10·2 per cent. of resin, 3·4 per cent. of proteids, and 2·6 per cent. of insoluble matter. The rubber was of very fair quality, although the percentages of resin and insoluble matter were higher than in some samples of Funtumia rubber from the Gold Coast previously examined. It was valued at 5*s.* per lb., with fine hard Para at 5*s.* 4*d.* per lb.

The dry lump rubber contained 78·5 per cent. of caoutchouc, 10·4 per cent. of resin, 7 per cent. of proteids, and 3·1 per cent. of insoluble matter. The specimen, as received, contained an excessive quantity of moisture, amounting to nearly 50 per cent. by weight. This rubber was valued at only 2*s*. 3*d*. per lb., with fine hard Para at 5*s*. 4*d*. per lb. The commercial value of this Funtumia rubber was therefore considerably enhanced by its conversion into crêpe.

Southern Nigeria.—Specimens of Para and *Ficus elastica* rubber were received from Southern Nigeria.

Para Rubber.—Two specimens of this rubber, prepared at Ebute Metta, were examined. One consisted of light-brown biscuits of rather rough appearance, most of which were well-prepared and in good condition. The rubber was of very good quality, containing 95 per cent. of caoutchouc in the dry material, with only 1·7 per cent. of resin and 2·3 per cent. of proteids; it was valued at 5*s*. per lb., with fine hard Para at 5*s*. per lb., and fine plantation Para at 5*s*. 1*d*. to 5*s*. 8*d*. per lb. If carefully prepared and placed on the market in good condition there is no doubt that the rubber would realise similar prices to fine plantation Para from the East, which it resembles in composition.

The second sample was a mass of scrap rubber of mixed character, containing a considerable amount of vegetable and mineral impurity. On account of the presence of this impurity the rubber was of inferior quality, containing only 76 per cent. of caoutchouc; it was valued at possibly 3*s*. per lb., with fine hard Para at 5*s*. per lb.

Ficus elastica Rubber.—A thin sheet of this rubber was forwarded from the Eastern Province. It was black and sticky externally, and deficient in strength, although containing 90·2 per cent. of caoutchouc. It was valued at only 3*s*. per lb., with fine hard Para at 5*s*. per lb. If the physical properties of this rubber could be improved, it would be of very good quality and would realise a satisfactory price.

East Africa Protectorate.—A specimen of Ceara rubber (*Manihot Glaziovii*) from trees about eighteen months old growing near Kisumu, which was submitted for examination, consisted of a small ball of light brown rubber, rather sticky externally and moist within. It contained 66·4 per cent of caoutchouc, calculated on the dry material, and abnormal amounts of resin, proteids and insoluble matter which adversely affected its physical properties. The sample was too small for trustworthy valuation, but such rubber would possibly realise about 3*s* per lb., with fine hard Para at 5*s*. per lb. This rubber was derived from very young trees, and the quality of the product may improve as the trees become older. It has been suggested that further samples derived from mature trees should, when available, be forwarded for examination.

Uganda.—The product derived from the latex of a wild fig was examined and found to be soft and sticky, possessing only slight elasticity and tenacity. It was of very resinous nature, like many of the products from species of Ficus, and it would have no commercial value.

Zanzibar.—Small samples of rubber, accompanied by botanical specimens of the tree yielding the product, were received from Pemba, and though too small for chemical examination appeared to be of good quality. The plant was identified at Kew as *Mascarenhasia elastica*, K. Schum. This rubber-yielding tree had not been recorded previously as occurring in Pemba.

A further specimen of the rubber was subsequently received consisting of small balls which were dark brown externally, but lighter and rather moist within when freshly cut. The rubber exhibited good physical properties. It contained 85·2 per cent. of caoutchouc, calculated on the dry rubber, and was valued at 4*s.* per lb., with fine hard Para at 8*s.* 10*d.* per lb. The material was of very fair quality and would be readily saleable.

Nyasaland.—A sample of Ceara rubber from Mlanje consisted of five biscuits of clean, well-prepared rubber, exhibiting very good elasticity and tenacity. The dry rubber contained 86·1 per cent. of caoutchouc, 6·8 per cent. of resin, and 6·2 per cent. of proteids; it was valued at 5*s.* 4*d.* per lb., with fine hard Para at the same price, and fine plantation Para biscuits at 5*s.* 4¾*d.* to 5*s.* 5¾*d.* per lb. Rubber similar to this sample would always be readily saleable at good prices.

A specimen of rubber of native preparation was also received, which, though too small for examination, appeared to be of good quality. Botanical specimens which accompanied it were identified as *Landolphia Thollonii*, a plant which had not been recorded previously from Nyasaland, but is well known as the source of root rubber in West Africa.

Transvaal.—The roots of *Raphionacme divaricata* were examined for comparison with the roots of *Raphionacme utilis*, which have been found to yield rubber in Portuguese West Africa. They contained a very small quantity of caoutchouc, but the yield from the dry material was too low to be of any importance. It is thus clear that if the roots examined were representative specimens, there is no possibility of utilising the plant as a source of rubber. It contains very much less caoutchouc than the allied plant *R. utilis*.

The product of a Euphorbia latex from Johannesburg was also investigated, and found to be of no commercial value.

Rhodesia.—A sample of latex from the Gwanda district was examined and found to yield a resinous product containing very little caoutchouc. The substance resembled the products furnished by Euphorbiaceous latices from South Africa previously examined at the Imperial Institute, and was of very little, if any, commercial value.

West Indies.—Specimens of rubber from Tobago, St. Lucia and Dominica have been examined.

A sample of *Castilloa elastica* rubber from Tobago was in the form of a square black sheet about ⅛ inch thick; the material was clean, dry, and well prepared. It contained 91·1 per cent. of caoutchouc, and was valued at 4*s.* 4*d.* per lb., with fine hard Para at 5*s.* per lb. This rubber would be easily saleable, and would realise a higher price if it could be prepared lighter in colour.

Further specimens of Castilloa rubber from Tobago were stated to have been prepared by a new centrifugal process, and were much paler than the preceding sample. The specimens were excellently prepared, but a little weak, and were valued at 6*s*. 10*d*. and 6*s*. 11*d*. per lb., with fine hard Para at 8*s*. 10*d*. per lb.

A small cake of *Castilloa elastica* rubber from St. Lucia was almost black, but was clean, well prepared, and of good quality. It contained 88·6 per cent. of caoutchouc and 9·1 per cent. of resin; it was valued at about 3*s*. 6*d*. per lb., with fine hard Para at 4*s*. 3½*d*. per lb. The amount of resin was rather high, but this defect may possibly disappear as the trees become older.

A specimen of Castilloa rubber from Dominica, which contained 84 per cent. of caoutchouc, was also valued at 3*s*. 6*d*. per lb., with fine hard Para at 4*s*. 3½*d*. per lb.

A sample of Para rubber from Dominica consisted of three biscuits of light-coloured, clean, well-prepared rubber, exhibiting good elasticity and tenacity. It contained 93 per cent. of caoutchouc, and was valued at 4*s*. 3*d*. per lb., with fine hard Para at 4*s*. 3½*d*. per lb., and plantation Para biscuits at 4*s*. 4*d*. to 4*s*. 11*d*. per lb. The rubber compared favourably with plantation Para rubber from the East, and there is no doubt that the Para tree will furnish excellent rubber in Dominica.

British Guiana.—The investigation of *Sapium Jenmani* rubber has been continued. Two samples of this material shown at the International Rubber Exhibition in London (1908) were examined. One sample consisted of thin biscuits of very fine pale amber rubber, excellently prepared and much superior in physical properties to the specimens of this material examined in 1908. It contained 93·7 per cent. of caoutchouc, and was valued at 4*s*. 3*d*. per lb., with fine hard Para at 4*s*. 3½*d*. per lb., and plantation Para biscuits at 4*s*. 4*d*. to 4*s*. 11*d*. per lb. There is no doubt that *Sapium Jenmani* rubber is of excellent quality, and that if carefully prepared it will realise very satisfactory prices in the market.

The second sample consisted of a block of scrap rubber, dark brown externally, but lighter within, and fairly clean and dry. It was of good quality, but inferior to the preceding specimen. It contained 88 per cent. of caoutchouc and was valued at 3*s*. to 3*s*. 3*d*. per lb., with fine Para at 4*s*. 3½*d*. per lb.

Timbers.

Countries of Origin.—Uganda, East Africa Protectorate, Natal, Northern Nigeria, Gold Coast, Sierra Leone, Mauritius, India, Western Australia, British Guiana, and United Kingdom.

In most cases the timbers submitted were examined with a view to the determination of their working qualities. In some cases mechanical tests were also made on the woods.

A sample of ebony from the East Africa Protectorate proved to be of very good quality, and was valued by experts at £6 to £7 per ton for logs 3 feet long by 8 to 16 inches square. *Podocarpus gracilior* timber from Uganda proved to be similar in quality to white or yellow pine. A number of woods were received from Natal for trial in pipe manufacture, but none of them proved to be of use in this direction. Forty-eight of the principal timbers

of Ashanti were examined. The majority of these were useful woods for constructional and other purposes locally, but certain of them resembled mahogany, cedar, and other well-known woods, and would realise good prices if exported to the United Kingdom. Four timbers received from Northern Nigeria included two mahoganies of fair quality, and a timber known as "Looka," which might find a market as "Cocus" wood. The examination of twelve of the chief timbers of Mauritius was completed by the determination of their mechanical properties. A sample of Jarrah sawdust was examined with a view to ascertaining whether a decoction of it could be used like cutch and other tanning materials for the treatment of coarse textiles in order to improve their resisting quality when made into bags for packing manures, etc. The experiments made did not give promising results. Four cedar-like woods were received from British Guiana for trial in cigar-box manufacture. One of these excited considerable attention among the manufacturers to whom it was submitted, and attempts are being made to arrange for an experimental shipment of this wood.

Technical information was supplied to the Mysore Government on various matters connected with the development and future prospects of the sandalwood industry in Mysore.

Oils and Oilseeds.

Countries of Origin.—East Africa Protectorate, Natal, Sierra Leone, Gold Coast, Southern Nigeria, Northern Nigeria, Mauritius, Fiji, Wei-hai-wei.

Seeds of Carapa sp.—Kernels of *Carapa* seeds from the Gold Coast were valued by a commercial firm at £11 5*s*. per ton. Similar samples were received from Sierra Leone; the dark kernels were regarded as worth £11 5*s*. per ton, and the light kernels at £11 10*s*. per ton. An offer was made by the firm mentioned to take 50 tons of the product from either country at the price quoted.

Castor Oil Seeds.—Eight samples of castor oil seed from the East Africa Protectorate were of good quality, and were valued by manufacturers at prices varying from £8 10*s*. to £9 17*s*. 6*d*. per ton, when East Indian castor seed was quoted at about £9 to £9 5*s*. per ton.

Three samples from Fiji were found to contain a normal quantity of oil, and were valued at about £9 to £9 10*s*. per ton.

Gorley Seed.—Two samples of this seed were received from Sierra Leone, and were found to contain about 47 per cent. of a solid fat, which consists of a mixture of a crystalline glyceride of chaulmoogric acid (about 85-90 per cent.) with a small proportion of glycerides of unsaturated acids. This fat furnishes a hard soap. It was suggested that a ton of the seed should be sent for technical trial. A herbarium specimen was supplied by means of which the "Gorley" plant was identified at Kew as *Oncoba echinata*.

Ground Nuts and Ground Nut Oil.—Specimens of ground nuts from Natal were of good quality but rather dry, and were regarded by commercial experts as worth £14 per ton (March, 1909).

A sample of large ground nuts was received from Fiji, the kernels of which were found to contain 49·1 per cent. of oil. It was too small for satisfactory valuation, but the kernels would probably realise the normal price of decorticated ground nuts of good quality, namely, £14 to £15 per ton.

A specimen of ground nut oil from Mauritius gave the usual constants for oil of good quality, and was valued at £30 per ton (July, 1909).

Ikpan Seeds.—A sample of these seeds was received from Southern Nigeria together with a statement that the product is sold locally at 3*d.* per lb. (equivalent to £28 per ton). It was pointed out that the seeds could not possibly realise this price in the United Kingdom. Accounts of the examination of Ikpan seed have been given in the *Bulletin of the Imperial Institute* (1907, Vol 5, p. 132, and 1908, Vol. 6, p. 356).

Linseed.—A sample of linseed from Natal was valued at £11 per ton (March, 1909).

Seeds of Pentaclethra macrophylla.—Consignments of these seeds, known as " Fai " beans, were received from Sierra Leone and Southern Nigeria. The seeds were submitted to manufacturers for technical trial, and, on expression, yielded 30 per cent. of oil. The oil and cake were analysed, and the results were found to agree with those furnished by samples previously examined. The seeds were regarded as worth £6 per ton.

Soy Beans.—Two samples of these seeds from Wei-hai-wei were examined and found to contain 17 and 17·1 per cent. of oil respectively. A large number of enquiries were received on the subject of soy beans, and articles on the cultivation and utilisation of the product were therefore published in the *Bulletin of the Imperial Institute* (1909, Vol. 7, p. 95, 308).

Numerous requests from merchants and manufacturers were received for information with reference to the production, export, commercial uses, and the cultivation and preparation of various oils and oil-seeds, and many specimens were received for identification.

A full investigation of the products of the different varieties of West African oil palm was carried out, and more than 100 specimens, including palm oils, palm kernel oils, fruits and kernels were examined. The report on this work was in course of preparation at the close of the year.

Volatile Oils.

Countries of Origin.—Cyprus, Anglo-Egyptian Sudan, Uganda, East Africa Protectorate, Zanzibar, Mozambique, Seychelles, Mauritius, Sierra Leone, Ceylon, India, Fiji, Jamaica, Dominica, Bahamas, United Kingdom.

Cyprus.—Specimens of marjoram herb and oil were examined. The plant was identified as *Origanum majoranoides.* The dried whole herb yielded 3·05 per cent. of oil closely resembling sweet marjoram oil in odour and properties. It was valued by experts at about 3*s.* 6*d.* to 3*s.* 11*d.* per lb. as a possible substitute for sweet fennel oil.

Specimens of the plant yielding Cyprus origanum oil have been identified as *Origanum dubium.* Two small consignments of re-

distilled origanum oil were forwarded to this country from Cyprus at the end of 1909, and analyses of these were made as a preliminary to the sale of the oils. These consignments were smaller than usual owing to the loss of a considerable stock of stored origanum herb by fire in Cyprus during 1909.

Two samples of laurel oil were reported on during the year. These were of very good quality, and contained about 55 per cent. of cineol. The demand for laurel oil is, however, small and uncertain, and it is not clear that a market can be found for much of this oil. At the end of the year myrtle and mint oils from Cyprus were under investigation.

Uganda.—Reference was made in last year's report (Cd. 4448-10), p. 38, to lemon-grass oil from Uganda, a first sample of which had then been examined. Lemon-grass is being grown in the Protectorate in areas which have been cleared of thick undergrowth with a view to destroying breeding places of the tsetse flies. Considerable areas have now been planted up with this grass, and it seems likely that large quantities of the oil will be marketed in the near future. Several consignments of the oil were shipped to London during 1909 and were sold in consultation with the Imperial Institute. As a rule the oil contains 75 per cent. of citral; it is of the "insoluble" type of lemon-grass oil, but is otherwise of good quality. The prices realised have ranged from 2*s.* 3*d.* to 2*s.* 8*d.* per lb., which is satisfactory in view of the low prices which ruled for lemon-grass oil in 1909.

Zanzibar.—A sample of clove leaf oil contained 85·7 per cent. of the chief odoriferous constituent, eugenol, and was valued at 3*s.* 4*d.* to 3*s.* 5*d.* per lb.

Seychelles.—Samples of cardamom oil and *Vitex trifolia* oil were received from this Colony. The cardamom oil only was of promising commercial value, and larger samples of this have been requested for valuation. Information was also supplied by the Imperial Institute regarding the market for vetiver oil in the United Kingdom and as to machinery and plant suitable for camphor distillation. At the close of the year ylang-ylang oil was under examination for the Seychelles.

Mauritius.—Samples of champaca perfume and of *Pimenta acris* fruits were received from Mauritius. The fruits yielded 3·3 per cent. of bay oil on distillation, and were valued at 18*s.* per cwt. A sample of cinamon leaves gave 1·10 per cent. of oil of good quality.

Sierra Leone.—*Ocimum viride* leaves collected before and after the flowering period of the plant yielded 0·86 and 0·89 per cent. of oil respectively. The former contained 55 per cent. and the latter 65 per cent. of thymol. A large sample of the oil was received from Sierra Leone at the end of the year, and is now being examined.

Fiji.—A number of samples of "lemon-grass oil" and of "bay oil" were examined. These were both of abnormal character; the lemon-grass oil partook of the nature both of lemon-grass and citronella oils, and the bay oil was low in phenols and had an odour somewhat resembling that of anise oil in addition to the

ordinary bay oil aroma. Enquiries are being made as to the botanical origin of these oils. Vetiver oil from the Colony and further samples of " bay " and " lemon-grass " oils were under examination at the end of the year.

West Indies.—Specimens of " petit grain oil " and " Pimento leaf oil " were examined from Jamaica; the former was abnormal in showing a low percentage of esters. From Dominica a series of orange and lime oils were received and were under examination at the end of the year. Cascarilla barks from the Bahamas were of good quality, and were valued at 55*s.* per cwt, for one sample and 65*s.* to 66*s.* for a second.

Other Countries.—A series of forty-three oils distilled from various species of Andropogon grown experimentally in Ceylon were under examination, as were also *Ocimum basilicum* and *Andropogon Iwarancusa* oils from the Sudan. The wood of the Ibean camphor tree from the East Africa Protectorate, and the tubers of a *Kaempferia* sp. from the Transvaal, were being investigated with a view to the determination of the nature of the volatile oils they contain. A number of other products containing volatile oils, and used for flavouring purposes, are dealt with under the heading " Spices " (p. 35).

Food-Grains, Feeding-Stuffs and Spices.

Countries of Origin.—Anglo-Egyptian Sudan, Nyasaland, Uganda, East Africa Protectorate, Rhodesia, Transvaal, Natal, Southern Nigeria, Northern Nigeria, Sierra Leone, Mauritius, Seychelles, India, Ceylon, Federated Malay States, Fiji, and United Kingdom.

Cereals.

Wheat.—The samples reported on included " durum " or " macaroni " wheats from India and Uganda and wheats from the East Africa Protectorate, where much attention is at present being given to the cultivation of this product. All these proved to be of good and readily saleable quality, and wheat merchants in London to whom samples were submitted were much interested in the possibility of finding new sources of supply, particularly in Uganda and East Africa. Other wheats from East Africa and Northern Nigeria were under examination at the close of the year.

Maize.—A sample of maize grown by natives in Nyasaland was valued at 25*s.* per quarter (October, 1909). Information was also furnished to the Government of Natal on the value of maize meal and hominy, prepared in that Colony, and to the Government of Mauritius with regard to various maize products.

Miscellaneous.—Barley from the Dongola Province, Sudan, was found to be of promising quality and suitable for malting, and was valued at 24*s.* per quarter of 400 lb. Rices prepared in Rangoon and in Europe were examined with a view to ascertaining the reason for the superior appearance of the rice prepared in Europe. This was found to be due to its having been polished with French chalk, which appears to be comonly used in minute quantity in polishing rice in Europe. Rice from Kano, Northern

Nigeria, was under examination at the close of the year. Millets were examined from Uganda and Northern Nigeria in continuation of previous work on this subject, and various millets were also identified for merchants in this country. Canary seed from East Africa proved to be of very good quality, and an experimental consignment to this country was suggested.

Leguminous Seeds.

A number of samples of peas and lupins were examined and valued for the Natal Government. The peas proved to be of saleable quality, but there is practically no demand for lupins in this country, owing to the fact that they require special treatment to render them innocuous as a feeding stuff.

Pigeon peas from Northern Nigeria, where this plant is being recommended for green manuring, proved to be of satisfactory composition, and were valued at £6 5*s*. per ton for feeding purposes. Analyses were also made of the seeds of *Leucaena glauca* from Mauritius and of "algarobilla" seeds in connection with the proposed use of these materials as feeding-stuffs. The peculiar properties of the former, however, precludes its general use in this way. Identification of various leguminous seeds were also supplied to merchants in the United Kingdom and information regarding the composition and value of such seeds for feeding purposes. Towards the end of the year a large number of varieties of beans which are being grown experimentally in the East Africa Protectorate were received for examination.

Flour and Starches.

A number of sweet potato products were received from Natal during the year in connection with a new industry started recently in that Colony for the manufacture of sweet potato flour and starch. These products are new to trade in this country, and consequently it was necessary to examine them in detail. It is not quite certain yet that any considerable market can be found for these products in this country, and further enquiries are being made. In connection with this industry some difficulty was experienced in dealing with a gummy residue formed in the course of manufacture and which led to considerable wastage of starch. Specimens of this residue were examined at the Imperial Institute, and a process for recovering the starch was devised, which is now being tried in Natal. Sweet potato meal and starch from Mauritius were also examined and valued. Cassava starches from Fiji, Mauritius and Southern Nigeria were analysed, and information was obtained indicating that these products could be used for sizing textile goods and in the manufacture of brewing sugars. Arrowroot starches from Fiji and Mauritius proved to be of good manufacturing quality. A sample of plantain flour from Madras was valued at £16 per ton.

Tea, Coffee and Cocoa.

Teas from Fiji, Mauritius and East Africa were analysed and submitted to experts for valuation. The two former resembled Indian teas in being rich in extractive matter, whilst they were rather low in caffeine, and in this respect were like China teas.

The samples were all of promising quality, and were valued at from 6*d*. to 7½*d*. per lb. Two coffees were received from the East Africa Protectorate, one was a plantation coffee of good quality and containing 1·19 per cent. of caffeine; the other a coffee collected from a wild species of Coffea discovered recently in the Nandi Forest of the Protectorate. This second sample was of interest in containing only 0·49 per cent. of caffeine. Both samples were valued at good prices, and arrangements were made with the Department of Agriculture for shipping consignments of these coffees to this country.

Two samples of cocoa were received from Fiji, which were valued at 54*s*. and 70*s*. per cwt. respectively (May, 1909). At the end of the year two cocoas prepared by special methods in the Gold Coast Colony were under examination.

Spices.

A series of twelve vanilla extracts and vanillas was received from the Seychelles in connection with a proposal to manufacture vanilla extract in that Colony. A process of preparing a concentrated extract without loss of flavour was devised at the Imperial Institute, and samples of this material were reported on favourably by users of vanilla in this country. Enquiries are now being made in the Seychelles as to the possibility of manufacturing this extract there on a commercial scale. Information was also supplied to the Government of the Seychelles as to the production of vanillin and other matters in connection with the vanilla industry. Analyses of a number of samples of cinnamon bark from the same Colony were also made, particularly with a view to ascertaining the cause of the inferior quality of some of the cinnamon bark oil distilled in the Islands. Memoranda describing the cultivation of ginger and its preparation for export were supplied to Ceylon, Northern Nigeria, and Sierra Leone. Samples of cinnamon bark, cloves, nutmegs, and mace were received from Mauritius and were examined and valued. All four proved to be of fair quality and of readily saleable types.

Tanning Materials.

Countries of Origin.—Cyprus, East Africa Protectorate, India, Federated Malay States, Hongkong, and United Kingdom.

A sample of sumach was received from Cyprus; it proved to be of good quality and to contain 26·9 per cent. of tannin. Barks of *Acacia cyanophylla* and *A. longifolia* from the same Colony contained 19 and 15 per cent. of tannin respectively, but gave rather dark-coloured leathers; they would be suitable for local use, especially in conjunction with better materials. A sample of supposed wattle bark from the Seychelles proved to be of rather poor quality, and the same applies to samples of Aleurites barks from Hongkong. Herbarium specimens of the tanning and other materials used in the preparation of Nigerian leather were received and identified.

At the close of the year a series of wattle barks from the East Africa Protectorate, where black wattle is being grown for fuel, was under examination, and also gambier leaves and twigs from

the Straits Settlements. A considerable number of enquiries from firms in the United Kingdom relative to tanning materials were also dealt with.

Natural Dyestuffs.

Countries of Origin.—Northern Nigeria, Southern Nigeria, Mauritius, Ceylon, India, Federated Malay States, and United Kingdom.

Native prepared indigos from Southern Nigeria and from Northern Nigeria were examined. The former consisted of the leaves and stems of *Lonchocarpus cyanescens*, and was of scientific interest only as a source of indigo; the Northern Nigeria sample was of poor quality, containing 21 per cent. of true indigo. The other products examined included orchella weed from Ceylon, logwood from Mauritius, dyes used for preparing leather in Northern Nigeria, annatto from the Federated Malay States, and an interesting series of herbarium specimens of plants from which West African red dyes, such as camwood and barwood, are derived. Information was supplied to Uganda regarding simple methods of dyeing with indigo. At the close of the year red and yellow dyestuffs from Nigeria were under investigation. Information respecting the prospects of the logwood industry was supplied to Jamaica.

Resins.

Countries of Origin.—Sudan, Uganda, Mozambique, Northern Nigeria, Southern Nigeria, Gold Coast, Gambia, India, Ceylon, Fiji, British Honduras, and United Kingdom.

Samples of " Gafal " gum from the Sudan were examined as an incense resin; they proved to be rather impure owing to the inclusion of bark, &c., but this product prepared in a clean state would be suitable for use as incense.

The dried latex of *Haronga madagascariensis* was received from Uganda. As this product presents a superficial resemblance to Gamboge (latex of *Garcinia* spp.), but differs considerably from the material in many of its propert es, a detailed chemical examination of it is being made. A series of copals was received from the Mozambique Company, and is still under examination. Samples of wood oil (African copaiba balsam) derived from *Daniella thurifera*, and of the resin formed on this tree by spontaneous exudation of the oleo-resin were received from the Gambia, Gold Coast, and Northern Nigeria. The naturally formed resin is used in West Africa as an incense resin, but appears unlikely to be of economic value in this country. A detailed chemical examination of the " wood oil " is being made.

Three copals from Southern Nigeria were also received for examination.

The examination of a number of samples of Indian turpentines and of Indian rosin was completed, and it was shown that rosin of excellent quality and quite equal to the best French and American rosins can be made by careful distillation of Indian turpentine. Enquiries are being made in India as to the possi-

bility of putting Indian rosin on this market cheaply enough to enable it to compete with the American product.

A series of eight samples of Indian lac was received, and is still under examination. The resin of *Gardenia latifolia* from Ceylon has been received for examination. The resin of *Dammara vitiensis* from Fiji was analysed, and technical trials made with it. It proved to be very similar to Manila copal and worth 35*s*. per cwt. as a varnish resin.

Gums.

Countries of Origin.—Sudan, Rhodesia, Mozambique, Northern Nigeria, Southern Nigeria.

The gum of a species of *Sterculia* from the Sudan was examined and proved to be of the tragacanth type. It was of very good quality and worth 45*s*. per cwt. for clean pieces, and probably higher prices could be obtained if it were prepared in flakes like tragacanth gum. This gum resembles that of *Cochlospermum Gossypium* from India in slowly evolving acetic acid when kept in a damp atmosphere.

A large number of samples of gums from Rhodesia and Mozambique were examined. Most of them were of poor quality, but a few were of promising character, and larger supplies of these have been asked for for examination and technical trial with a view to more definite valuation. At the close of the year a number of Nigerian gums were under examination.

Drugs.

Countries of Origin. — Rhodesia, Mozambique, Southern Nigeria, Gold Coast, Sierra Leone, India, Ceylon, Fiji, and United Kingdom.

The drugs examined included a specimen of so-called "bitter kola" from Southern Nigeria, Yohimbehe bark received through Southern Nigeria from the Cameroons, and a series of native drugs from Sierra Leone and Mozambique. Of these the "bitter kola" proved to contain no caffeine, and was therefore of no value as a substitute for true kola. The botanical origin of these "bitter kola" nuts, of which several samples have been received at the Imperial Institute in recent years, has not yet been determined. They differ considerably in appearance from true kola nuts, and are not likely to be substituted for them. A specimen of m'vara-vara roots from Mozambique was found to contain methyl salicylate and a saponin-like substance, but neither of these was present in quantity sufficient to make the material of economic value.

A sample of the Fai bean bark used as an anthelmintic by natives in Sierra Leone was examined. It yielded a considerable quantity of a crystalline neutral substance, but no substance exhibiting marked physiological activity could be isolated from it. Similarly *Cassia Sieberiana* pods also used in native medicine in Sierra Leone furnished only indefinite physiologically inactive substances.

A specimen of a so-called "scurvy" plant was received from Rhodesia. This material is used as a spinach plant by labourers

in the Gold Mines, and during the season in which it is available cases of scurvy are rare, but during the winter when the plant is unobtainable scurvy is prevalent. The plant was found to be rich in potassium nitrate and vegetable acids, and on the basis of these results attempts are now being made to grow vegetables rich in these constituents for native use during the winter.

A large number of investigations were undertaken on Indian drugs. Twenty-one samples of Indian aconites were under examination, including the following species: — *Aconitum heterophylloides*, *A. spicatum*(?), *A. laciniatum*, *A. laciniatum*, x *A. spicatum*, *A. Soongaricum*, *A. palmatum*, and other unidentified species. Work on the isolation of the alkaloids characteristic of each made considerable progress.

Strychnos potatorum seeds from India were found to yield a trace of alkaloid, but this was too small in amount to be isolated and identified.

The whole plants of *Hyoscyamus reticulatus* from Baluchistan were found to contain 0·116 to 0·240 per cent. of total alkaloid, chiefly hyoscyamine, whilst 0·082 per cent. of total alkaloid was present in the seeds. *Datura Stramonium* from Madras and the Punjab yielded in some cases hyoscyamine alone, in others scopalamine alone, but generally a mixture of the two alkaloids with possibly a third unidentified alkaloid in one sample of roots from the Punjab. No atropine was found in any of the samples examined. The percentage of alkaloids present in this Indian Stramonium was on the whole equal, if not superior, to that generally found in the European plant.

Datura fastuosa from Assam contained scopolamine as the predominant alkaloid in the twigs and leaves and this alkaloid alone in the roots. The quantity present was about the same as that recorded for this plant in Europe.

Datura metel from the Punjab was under investigation in continuation of this work at the close of the year.

Over 100 samples of poppy-heads, opiums, soils and other products collected from the chief opium-producing districts in India were received during the year for examination in connection with a general investigation of opium-production in India, and considerable progress was made with the analysis of these products. In the same connection a memorandum dealing with improvements in a new process of opium alkaloid manufacture was supplied to the Indian Government.

A sample of coca leaves from Ceylon contained 1·2 per cent. of total alkaloids soluble in light petroleum, and was valued at 9*d.* per lb.

A memorandum on " tonga " bark and root was supplied to the Government of Fiji, and information respecting the production, manufacture, sale, and physiological effects of cocaine and cocaine substitutes was submitted, at the request of the Colonial Office, in connection with the increasing use of cocaine as a drug in tropical Colonies.

Samples of codeine phosphate of British manufacture were examined for the Foreign Office in connection with difficulties which have arisen in connection with its export to foreign countries.

Plants Reputed to be Poisonous to Cattle.

Countries of Origin.—Rhodesia, Transvaal, Cape Colony, and India.

The products examined included the leaves and seeds of *Tephrosia Vogelii*, used as a fish poison in Rhodesia, and *Senecio latifolius* from Cape Colony. The latter contained two new alkaloids which have been named senecifoline and senecifolidine, and a full account of the chemistry of this plant has been published by Dr. H. E. Watt, of the Scientific and Technical Department, in the "Transactions of the Chemical Society," 1909, Vol. 96, p. 466. The investigation of the physiological action of these alkaloids has been undertaken for the Imperial Institute by Dr. Cushny, F.R.S., of University College, London. This work has been extended to *Senecio jacobaea*, which causes in Nova Scotia the "Pictou Cattle Disease," which seems to be quite similar in character to that induced in cattle by *Senecio latifolius* in South Africa. *Ornithoglossum glaucum*, *Homeria pallida*, and *Acokanthrea venenata*, which also cause cattle poisoning in South African Colonies, are under investigation.

Tobaccos.

Countries of Origin.—Nyasaland, Uganda, East Africa Protectorate, Mozambique, Rhodesia, Northern Nigeria, Sierra Leone, India, British Guiana, Bermuda, and United Kingdom.

Pipe Tobaccos.—The production of bright pipe tobaccos has now become well established in Rhodesia and Nyasaland, and experimental production of this type of tobacco is also being attempted in India, the East Africa Protectorate, and elsewhere. From East Africa five samples of bright "Virginian" tobacco were received and examined. These proved to be of fair quality, and were valued at 3½*d.* per lb. Five samples from Nyasaland proved to be of very good quality, and were valued by manufacturers at 9*d.*, 8*d.*, 7*d.*, 6*d.*, and 5*d.* per lb. respectively. A very satisfactory feature of these tobaccos was their good burning quality, which was superior to that of many United States tobaccos of the same type. Twelve tobaccos of this class were also received from India, but these proved to be of rather poor burning quality, and were not likely to be saleable in this country; recommendations were made for the better cultivation and preparation of this tobacco. At the end of the year tobaccos of this type sent by the Mozambique Company were under examination.

Turkish Tobacco.—Special attention is being given to this class of tobacco at the Tobacco Experimental Station, Uganda, and three samples were received thence during the year. These were of promising quality, and the best of them was valued by manufacturers in this country at 5*d.* to 6*d.* per lb. A sample of wood ash, which was proposed for use as a tobacco manure in Uganda, was analysed and found to contain enough potash to be suitable for this purpose. Turkish tobaccos were also received from the East Africa Protectorate and India, but proved to be unsatisfactory in appearance and quality.

Cigar Tobacco.—Tobaccos of this class were received from British Guiana, India, Northern Nigeria, Sierra Leone, and the

East Africa Protectorate. The West African samples were badly prepared but burned well, indicating that good tobacco could probably be grown there under expert advice, which is essential in attempting the production of cigar tobacco. From Bermuda, in connection with the experiments in progress there on the cultivation of cigar tobacco, samples of soil, seaweed ash, and sage-bush ash were received for examination. The two latter were examined as possible manures for tobacco, but the sage-bush ash only would seem to be suitable for this purpose.

Miscellaneous.—These included various tobaccos affected by fungoid or insect pests, and requests for advice regarding the cultivation or preparation of various types of tobacco.

Miscellaneous.

Countries of Origin. — Rhodesia, Mozambique, Northern Nigeria, India, Bermuda, Newfoundland, West Australia.

In this group are included a number of products and enquiries which do not fall into any of the classes dealt with already.

Bulbs of *Lilium Harrisii* were received from Bermuda for valuation. The bulbs were of a kind likely to find a ready sale in this country at prices ranging from 20*s*. to 40*s*. per 100, depending on the size of the bulbs and provided that they arrived here in perfect condition.

Papain from the Seychelles proved to be of good quality, and the makers were given information regarding the market for this product. Soap nuts from Mysore were tried as a substitute for soap bark, but proved to be less efficient as an emulsifying agent for oils and similar products.

Memoranda on the utilisation of seaweed as a source of iodine and algin were supplied to various enquirers, and numerous enquiries relating to the cultivation of tropical products and to similar matters were dealt with. Several analyses were also made for the Board of Trade in connection with the classification of disinfectants by foreign Customs Authorities.

Analyses were made for the Newfoundland Government, of "kelp" made from two seaweeds, *Laminaria longicruris* and *L. Cloustonii*. The second only proved to be rich enough in iodine to be saleable, and was valued at £7 to £8 per ton as a source of this substance, but the ash was rich enough in potash to be worth consideration for manurial purposes also.

Animal Products.

Countries of Origin.—Cyprus, Anglo-Egyptian Sudan, Mozambique, Transvaal, Seychelles, Mauritius, Bahamas.

The materials reported on included goat-skins from Cyprus and monkey-skins from Mauritius, both of which proved to be of rather poor but saleable quality; trepang from the Sudan, which was unsuitable for this market; pearls and pearl oyster shells received from the Mozambique Company, which were of low value; and sponges from the Seychelles, which were not of a saleable type.

Locusts from the Transvaal were analysed and submitted to experts for trial as a poultry food. They were readily eaten by

fowls, but presented no special advantages as a poultry food. It seemed likely, however, that they would be saleable in this country for this purpose.

A memorandum was supplied to the Seychelles Government on the protection and breeding of turtles.

Towards the end of the year a sample of supposed pearl shells was received from the Bahamas for examination.

General Enquiries.

The foregoing sections describing the work of the Scientific and Technical Department relate mainly to materials submitted for investigation through official channels. In addition to this class of work an increasing number of enquiries of a commercial character, involving scientific and technical questions, is now being received each year. These enquiries are chiefly of two classes—(1) requests for advice from officials of technical departments in the Colonies and India as to the cultivation of new products, the commercial value of little known materials or methods of marketing produce, and (2) requests from merchants and manufacturers chiefly in the United Kingdom for information as to new sources of raw materials, identifications of natural products, advice regarding the cultivation of new materials in the Colonies, &c.

The number of such enquiries dealt with in 1909 was 270, exclusive of those relating to settlement, emigration and other matters.

As indicating the general scope of these enquiries, the following specimens may be given:—

1. Request for information as to the distribution of workable deposits of graphite in India.
2. Enquiry for information on the various methods of utilising barium minerals.
3. Advice as to the minimum limits for the remunerative working of sands containing tinstone.
4. The possibility of utilising corundum as a source of aluminium.
5. Request for information regarding the cultivation of Furcraea, machinery for decorticating the fibre, value of the latter, methods of marketing, &c.
6. Information as to the relation between English and French cotton "counts."
7. Names of oil-seeds not at present utilised owing to difficulties of "shelling," with notes on the countries in which such seeds could be produced on a large scale.
8. Methods of cultivating lemon-grass and preparing lemon-grass oil.
9. Information on the cultivation, preparation and marketing of ginger and cinnamon bark.
10. Names of British Colonies in which "algarobilla" might be profitably cultivated.
11. Simple methods of dyeing with indigo, suitable for the use of natives.

12. Information as to the production and trade in Japanese lacquer.
13. Information regarding Indian drugs likely to find a market in this country and the methods to be followed in exporting such products.
14. Information as to the cultivation of the papaw and methods of preparing papain.
15. The possibility of producing "industrial alcohol" as a by-product in cane-sugar manufacture and its use as a fuel.
16. Information as to the various uses of seaweed.
17. Data relating to the preparation of canned fish, especially as regards "canning" machinery, equipment of steam trawlers and manufacture of suitable salt.

VIII.—SUBSIDIARY WORK.

During the year meetings and receptions have been held at the Imperial Institute by the British Women's Emigration Association, Colonial Nursing Association, Anglo-Russian Literary Society, National Indian Association, Committee of the Indian Women's Scholarship Fund, Royal British Nurses' Association, and the International Congress on Applied Chemistry. The International Congress on Alcoholism was given extensive accommodation for its meetings and demonstrations in July, 1909, and a portion of the North Gallery was utilised for the purpose of an exhibition. A reception to the delegates was also given at the Imperial Institute by His Majesty's Government, when the guests were received by the Right Hon. Lewis Harcourt. The Crown Prince of Sweden and several of the Governors of the Colonies were present on this occasion.

COLONIAL REPORTS.

The following recent reports relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
620	Barbados	1908–1909
621	Trinidad and Tobago	,,
622	Straits Settlements	1908
623	Somaliland	1908–1909
624	Mauritius	1908
625	St. Vincent	1908–1909
626	Jamaica	,,
627	Swaziland	,,
628	Grenada	1908
629	Leeward Islands	1908–1909
630	Southern Nigeria	1908
631	British Honduras	,,
632	British Guiana	1908–1909
633	Northern Nigeria	,,
634	Basutoland	,,
635	East Africa Protectorate	,,
636	Uganda	,,
637	Weihaiwei	1909
638	St. Helena	,,
639	Northern Territories of the Gold Coast	,,
640	Ashanti	,,
641	Gambia	,,
642	Malta	1909–1910
643	Seychelles	1909
644	Colonial Survey Committee	1909–1910
645	Falkland Islands	1909
646	Turks and Caicos Islands	,,
647	Gibraltar	,,
648	Sierra Leone	,,
649	Somaliland	,,
650	Bahamas	1909–1910
651	Tongan Islands Protectorate	1909
652	Bechuanaland Protectorate	1909–1910
653	Ceylon	1909
654	Gold Coast	,,
655	Nyasaland	1909–1910

MISCELLANEOUS.

No.	Colony, &c.	Subject.
64	Uganda	Botany and Forestry.
65	Do.	Sleeping Sickness.
66	Gold Coast	Forests.
67	Southern Nigeria	Mineral Survey, 1905–6.
68	Do. do.	Do. do. 1906–7.
69	St. Helena	Fisheries.
70	Colonies	List of Laws relating to Patents, Trade Marks, &c.
71	Imperial Institute	Foodstuffs.
72	Fiji	Hurricane, 1910.
73	Jamaica	Cayman Islands.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By DARLING & SON, Ltd., 34-40, Bacon Street, E.

1910.

COLONIAL REPORTS—ANNUAL.

No. 687.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, 1910.

(For Report for 1909, *see* No. 656 [Cd. 4964-30] of 1910.)

Presented to both Houses of Parliament by Command of His Majesty.
September, 1911.

LONDON:
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.
To be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LTD., FETTER LANE, E.C., and
32, ABINGDON STREET, S.W.; or
OLIVER AND BOYD, TWEEDDALE COURT, EDINBURGH; or
E. PONSONBY, LTD., 116, GRAFTON STREET, DUBLIN.

PRINTED BY
DARLING AND SON, LTD., BACON STREET, E.
1911.

[Cd. 5467-23.] *Price* 2½*d.*

No. 687.

IMPERIAL INSTITUTE, 1910.

(For Report for 1909, *see* No. 656 [Cd. 4964–30.] of 1910.)

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE IN 1910. BY PROFESSOR WYNDHAM R. DUNSTAN, M.A., LL.D., F.R.S., *Director*.

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I.—PREFATORY STATEMENT.

THE IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA.

Trustees.

The First Commissioner of His Majesty's Treasury.
The Secretary of State for the Colonies.
The Secretary of State for India.
The President of the Board of Trade.

Advisory Committee.

(Appointed under the provisions of the Imperial Institute Transfer Act, 1902.)

The Right Hon. Lord Northcote, G.C.M.G., G.C.I.E., C.B. (Chairman).
The Right Hon. Lord Allerton.
Sir F. Hopwood, G.C.M.G., K.C.B.
Sir A. E. Bateman, K.C.M.G.
Sir H. Llewellyn Smith, K.C.B.
G. Miller, Esq.
The Right Hon. Sir C. Clementi Smith, G.C.M.G.
C. A. Harris, Esq., C.B., C.M.G.
Sir T. H. Holland, K.C.I.E.
Sir T. W. Holderness, K.C.S.I.
Sir K. G. Gupta, K.C.S.I.
Sir Thomas Elliott, K.C.B.,
The Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., G.C.V.O.
Captain R. H. Muirhead Collins, C.M.G.
The Hon. Sir R. Solomon, G.C.M.G., K.C.B., K.C.V.O.
The Hon. Sir. W. Hall-Jones, K.C.M.G.
P. L. Ashley, Esq., *Secretary*.

Managing Committee.

C. A. Harris, Esq., C.B., C.M.G. (nominated by the Colonial Office).
Sir A. E. Bateman, K.C.M.G. (nominated by the Board of Trade).
Colonel D. G. Pitcher (nominated by the India Office).

Director.

Professor Wyndham R. Dunstan, M.A., LL.D., F.R.S.

The Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of the Colonies and India, and providing for their investiga-

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tion and for the collection and dissemination of scientific, technical and commercial information relating to them.

The work of the Imperial Institute is at present carried on under four principal divisions: (1) the Colonial and Indian Collections, consisting mainly of raw materials and primary manufactures displayed in the public exhibition galleries, and including a Central Stand for receiving enquiries and distributing publications; (2) the Scientific and Technical Department, including a special staff and research laboratories, occupying the second floor of the building; (3) the Reference Library, containing a large collection of works of reference relating to the Colonies and India, together with the principal periodicals and newspapers; (4) the *Bulletin of the Imperial Institute*, a quarterly publication containing a record of the work of the Imperial Institute in its various branches, as well as special articles on subjects connected with the industrial utilisation of mineral and vegetable products.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which His Royal Highness the Prince of Wales (afterwards King Edward VII.) was President, and an Executive Council, including representatives of the Indian Empire, and of all the British Colonies and Dependencies. In 1900 the building became the property of His Majesty's Government, by whom the western portion and galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portions being assigned, subject to rights of usage, for occupation by the University of London. In July, 1902, an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee, including representatives of the Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A Committee of Management of three members, one nominated by each of the three Government Departments chiefly concerned, has been appointed, and at present consists of Mr. C. A. Harris, C.B., C.M.G., Sir Alfred Bateman, K.C.M.G., and Colonel Duncan Pitcher (late Indian Army).

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and to the commercial utilisation of economic products.

The following are the principal departments of the Institute:—

Exhibition Galleries.—The collections of economic products, &c., illustrative of the general and commercial resources of the Colonies and India, are arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter.

The following British Dominions, Colonies and Dependencies are represented by collections, which are in charge of Technical Superintendents:—

Canada, Newfoundland, Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahama Islands, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda, Falkland Islands, New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, New Zealand, Fiji, Union of South Africa, Rhodesia, Nyasaland, St. Helena, Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, East Africa Protectorate, Zanzibar and Pemba, Uganda, Somaliland, the Anglo-Egyptian Sudan, Malta, Cyprus, Ceylon, Hong Kong, Mauritius, Seychelles, Straits Settlements, the Federated Malay States, and India.

Special arrangements are made for the conduct of schools and institutions desirous of visiting the Colonial and Indian collections for educational purposes.

A stand has been opened in the centre of the main gallery to facilitate the supply of general information, and the distribution of literature. Pamphlets, circulars, handbooks, &c., containing information relating to the commerce, agriculture, mining, and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. Lists of the publications available for distribution are obtainable on application. The principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the departments in the main building.

The Scientific and Technical Department.—The research laboratories of this department, which occupy the second floor of the Imperial Institute, were established in order to provide for the investigation of new or little-known natural products from the Colonies and India and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade and industries of the Colonies and India.

The work of this department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have been also made by the Foreign Office, whereby British representatives abroad may transmit to the department for investigation such natural products of the countries in which they are appointed to reside as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the department, and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

Except under special circumstances investigations are not undertaken for private individuals.

A reference sample room is maintained in this department, in which are arranged samples of the principal materials which have been investigated and valued commercially during recent years, and as to which full information is available.

The Scientific and Technical Department works in co-operation with the Agricultural and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations and enquiries as are of a special scientific and technical character connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial value of products (vegetable or mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which has been printed in a volume of Technical Reports and Scientific Papers, published in 1903. A series of selected reports is now being issued in the Miscellaneous Series of Colonial Reports. Of these selected reports, three parts have been published: Part I., "Fibres" (Cd. 4588); Part II., "Gums and Resins" (Cd. 4971); Part III., "Foodstuffs" (Cd. 5137); whilst others are in active preparation.

Mineral surveys, under the supervision of the Director of the Imperial Institute, and conducted by surveyors selected by him, are in progress in Ceylon and in Southern Nigeria. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained. Reports by the Director on the results of mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

African Tropical Service Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction in the subject of tropical cultivation and products in this course is given by members of the staff of the Imperial Institute.

Library and Reading-Rooms.—The Library and Reading-Rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference, and are regularly supplied with the more important official publications, and with many of the principal newspapers and periodicals of the United Kingdom, the Colonies and India.

The library and reading-rooms are on the first floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for

the use of Life Fellows of the Imperial Institute, and of other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownaggree corridor and rooms in connection with this Hall are in the occupation of the Indian Section of the Imperial Institute, whilst the Hall is available for lectures, meetings, &c.

The *Bulletin of the Imperial Institute* is published quarterly, price one shilling (annual subscription 4*s.* 8*d.*, including postage), and may be purchased from Messrs. Eyre and Spottiswoode, Ltd., East Harding Street, Fleet Street, London, E.C., or from agents in the Colonies and India. The *Bulletin* contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (vegetable and mineral).

The following societies have their headquarters at the Imperial Institute:—

International Association of Tropical Agriculture and Colonial Development, British Section.—The object of this Association, the Central Bureau of which is in Paris, is the promotion of the scientific and practical study of all questions connected with tropical agriculture and the development and utilisation of natural resources, especially of tropical countries. The British Section has its headquarters at the Imperial Institute. Members of the British Section are permitted to use the library and reading-rooms of the Imperial Institute, and a writing-room has been also assigned for their use.

British Women's Emigration Association.—The British Women's Emigration Association has been assigned offices on the mezzanine floor, which are open daily from 10 a.m. to 4 p.m., and advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge.

Colonial Nursing Association.—This Association has been assigned an office on the mezzanine floor of the Imperial Institute. Its principal object is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependenc

African Society.—This Society, which is concerned with the discussion and publication of all matters connected with British African Possessions, has been assigned an office on the mezzanine floor, and holds meetings for the discussion of African questions. The *Journal of the African Society* is published quarterly.

Imperial Co-operation League.—This League has been assigned an office on the mezzanine floor. The object of the League is to promote the closer union of the Empire, more particularly in regard to co-operation between the United Kingdom and the Self-Governing Dominions in matters of defence and Imperial Policy.

II.—GENERAL.

The present report relates to the work which has been carried out in the several departments of the Imperial Institute during the year 1910, and is in continuation of previous reports (Report for 1906 and 1907, Cd. 3729-48; Report for 1908, Cd. 4448-10; Report for 1909, Cd. 4964-30)

In each of its departments the work of the Imperial Institute shows continued progress, and it is satisfactory to state that the financial support afforded to it by the Dominions and Colonies continues to increase.

The chief difficulty experienced at present is want of space for the great extension of the operations of the Institute which has occurred in recent years. This has been commented on in previous reports, and is naturally increasingly felt each year. In particular there is a pressing need for more space for storage, for temporary exhibitions, and for the work of the Scientific and Technical Department, whilst it is impossible at present to offer accommodation to several societies carrying on Imperial work of the character included in the objects for the promotion of which the Imperial Institute was founded.

The more important features of the work in each department of the Institute during 1910 are recorded in the following sections.

III.—STAFF.

During the year 1910 the principal members of the staff were as follows:—

Director of the Imperial Institute:—
Wyndham R. Dunstan, M.A., LL.D., F.R.S.

Director's Office.

Secretary to the Director:—
Major E. J. Lugard, D.S.O.
Assistant-Secretary to the Director:—
J. J. K. Greenway, B.A. (Cantab.)
Clerk:—
C. L. Hare, M.A. (Oxon.), (until August, 1910).

Scientific and Technical Department.

Superintendent of Laboratories:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
Technical Superintendent:—
Harold Brown.
Principal Assistant:—
E. Goulding, D.Sc. (Lond.), F.C.S.
Special Assistants:—
H. H. Robinson, M.A. (Oxon.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
B. E. Long, B.A. (Cantab.).

Senior Assistants:—
T. Crook, A.R.C.S.I., F.G.S.
A. E. Andrews, F.C.S.
S. J. Johnstone.
R. G. Pelly, F.I.C.
S. J. M. Auld, Ph.D. (Würzburg), D.Sc. (Lond.)
F. W. Barwick (Mercer's Company's Research Fellow), (until July, 1910).
S. S. Pickles, D.Sc. (Vict.).

Assistants:—
J. R. Hill, B.A. (Cantab.), (until August, 1910).
W. O. R. Wynn.
V. M. Weil, B.Sc. (Lond.), (until January, 1910).
N. C. Akers, A.I.C.
G. M. Davies.
O. D. Roberts, A.I.C.
J. Shelton, A.I.C.
L. Wilson, B.Sc. (Lond.).
B. W. Whitfeild.
G. T. Bray.
J. R. Furlong, Ph.D. (Würzburg).
H. W. Winter.

The special officers of the Mineral Surveys of Ceylon and Southern Nigeria which have been in progress under the supervision of the Director of the Imperial Institute, were:—

Ceylon:—
J. S. Coates, B.A. (Cantab.).
J. A. Daniel, B.A. (Cantab.), (until September, 1910).
F. D. Paisley, B.A. (Cantab.).

Southern Nigeria:—
A. E. Kitson, F.G.S., F.R.G.S., M.Aust.I.M.E.
E. O. Thiele, B.Sc. (Melbourne), (until December, 1910).
A. D. Lumb, A.R.S.M., F.G.S. (in succession to Mr. Thiele).

EXHIBITION GALLERIES.—COLONIAL AND INDIAN COLLECTIONS.

Technical Superintendents:—
W. G. Freeman, B.Sc. (Lond.), F.L.S.
S. E. Chandler, D.Sc. (Lond.), F.L.S.
H. Spooner.
A. B. Jackson.

AFRICAN TROPICAL SERVICE COURSE.

Instructors in Tropical Cultivation:—
W. G. Freeman, B.Sc. (Lond.), F.L.S.
S. E. Chandler, D.Sc. (Lond.), F.L.S.

Instructors in Tropical Products:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
Harold Brown.
E. Goulding, D.Sc. (Lond.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
R. G. Pelly, F.I.C.
F. W. Barwick (until July, 1910).

The following members of the Staff have left to fill the appointments indicated:—

Mr. E. O. Thiele, B.Sc. (Melbourne), Assistant Mineral Surveyor in Southern Nigeria, was appointed Chief Mineral Surveyor for the Mineral Survey of the Mozambique.

Mr F. W. Barwick, Mercers' Company's Research Fellow at the Imperial Institute, was appointed Manager of the Public Testing and Conditioning House of the Belfast Corporation.

Mr. J. R. Hill, B.A. (Cantab.) was appointed Government Chemist to the Institute of Medical Research at Kuala Lumpur in the Federated Malay States, in succession to Mr. B. J. Eaton, formerly an Assistant at the Imperial Institute, who has been appointed Agricultural Chemist in the Federated Malay States.

Mr. V. M. Weil, B.Sc. (Lond.), was appointed Assistant Government Chemist in the Leeward Islands.

IV.—PUBLIC EXHIBITION GALLERIES.

The principal aim of the Colonial and Indian Collections is to illustrate, by means of exhibits, chiefly consisting of raw materials and primary manufactures, the commercial and industrial resources of the various parts of the British Empire, and to present a view of their general economic position.

The Ceylon Government having sanctioned a scheme for the extension and improvement of the Ceylon Court, a large number of important exhibits have been supplied, new show-cases provided, and the whole court rearranged. When completed the court will be a most satisfactory representation of the present position and resources of the Colony.

Among other collections which have been considerably extended and improved are those of Uganda, Fiji, and the Falkland Islands.

The Indian Section has also been largely added to, and an exhibit illustrating the Indian tea industry, including a statistical board and numerous photographs, has been provided by the Indian Tea Association. A valuable collection of Indian coins, with a handsome teak showcase for their accommodation, was presented by the Maharajah of Gwalior.

The Mauritius Court has been entirely rearranged and a number of new exhibits from the Colony incorporated.

A new window has been provided at the north-east corner of the Eastern Gallery, which has greatly improved the lighting of the Malay Court.

A scheme for a considerable extension of the Newfoundland Court and for the provision of new exhibits has been sanctioned by the Newfoundland Government, and will shortly be carried into effect.

The New South Wales Court has been rearranged and a great improvement effected by the addition of new exhibits provided by the Agent-General.

Additional exhibits, including economic products, photographs, maps, &c., have been received for the courts of the following Colonies:—

Cape of Good Hope, Natal, Orange River Colony, Transvaal, Rhodesia, Nyasaland, East Africa Protectorate, Uganda, Sudan, Northern Nigeria, Southern Nigeria, Sierra Leone, Seychelles, Falkland Islands, British Guiana, Antigua, Bermuda, British Columbia, New Zealand, Tasmania, Victoria, Queensland, South Australia, Fiji.

Several additions have been made to the Royal presents and addresses which are graciously lent by Their Majesties the King and Queen for exhibition in the Public Galleries.

The Reference Collection, in the Upper East Gallery, of the principal standard commercial products of the world, was further extended, and has proved of great value to visitors from the Colonies, and has facilitated the comparison of new products received from the Colonies with those of established commercial and industrial value.

A descriptive catalogue of the Windward Islands exhibits was prepared and printed in the *Bulletin of the Imperial Institute*, Vol. VIII. (1910), No. 1, separate copies being available for distribution to applicants at the Central Stand in the Galleries.

A collection of specimens of economic products was presented to the Bristol Museum, and a large number of collections of specimens of Colonial and Indian products has been issued to schools for use in connection with the teaching of economic geography, and in the formation of school museums. Special loan collections illustrating the economic products of India and New Zealand respectively, in addition to existing loan collections of Canada, Australia and South Africa, were prepared for circulation to certain schools in connection with the Victoria League. Exhibits were lent to the Colonial Fruit Show which was held at the Royal Horticultural Hall in London in December.

A number of visits to the Public Galleries have been made by parties of students from schools, who have been personally conducted through the Galleries by the Technical Superintendents.

The number of visitors to the Exhibition Galleries during 1910 was 167,440, as compared with 162,802 during the preceding year, and 14,056 publications relating to the Colonies and India were distributed to enquirers at the Central Stand, compared with 10,936 distributed in 1909. Many special enquiries regarding emigration and tropical agriculture were dealt with.

V.—THE LIBRARY.

Lists of the chief works, excluding official publications, which were added to the Library in the course of the year have been published in the *Bulletin of the Imperial Institute.*

In addition to its use by the staff and by Life Fellows, the Library is largely consulted by enquirers for special information and other visitors who are duly introduced.

VI.—"BULLETIN OF THE IMPERIAL INSTITUTE," AND OTHER PUBLICATIONS.

Bulletin of the Imperial Institute.

The following are the titles of the articles which have appeared in the quarterly numbers of the Bulletin, Vol. VIII. (1910).:—

Reports on Investigations:—

Economic Products from Mauritius.
Rubbers from Sierra Leone.
Tartar Gum from the Sudan.
Wheats from African Colonies and India.
Sunn Hemp from India.
Rubbers from the West Indies.
Ceará Rubber from Nyasaland.
Some West African Timbers.
Wattle Barks from the Transvaal and the East Africa Protectorate.
Edible Beans from the East Africa Protectorate.
Funtumia Rubber from West Africa.
Landolphia Rubber from the Sudan.
Para Rubber (*Hevea brasiliensis*) in Southern Nigeria.
The Rubber of *Mascarenhasia elastica.*
Gums from Northern Nigeria.
Coffee from the East Africa Protectorate and Rhodesia.
Maize from Nyasaland and the Gambia.
Lac Resin from Baroda, India

Special Articles:—

Preparation of Beeswax.
The Natural Varnishes of China and Japan.
Cultivation and Utilisation of Soy Bean.
Prickly Pear and its Utilisation.
New rubber-yielding plants in Mexico.

Special Articles—continued.

Economic Development of German Protectorates in Africa.
International Congress of Tropical Agriculture and Colonial Development.
The Cultivation, Preparation, and Utilisation of the Ground Nut.
The Cultivation and Preparation of "Bright" Tobaccos.
Mauritius Hemp.
Burmese Black Varnish or Lacquer.
The Distribution and Utilisation of Chromium Ores.
Cotton and Rubber in Nyasaland.
The Poisonous Properties of Immature Sorghum.
Production and Use of Coca Leaves.

General Notes:—

Mineral Survey of Southern Nigeria.
Manufacture of Charcoal Briquettes in the East Africa Protectorate.
Agave Fibres from India.
A New Palm-nut Cracking Machine.
Coca Cultivation in Peru.
Production of Cinchona Bark.
Wattle Barks from German East Africa.
Cotton-Growing in French Colonies.
The Relative Value of the Principal Tanning Materials.
The Manufacture of Hydraulic Cement from Blast Furnace Slag.
Heveas in West Africa.
South African Maize and Kaffir Corn; Season 1910-11.
Camphor Production in German East Africa.
Quebracho Wood.
The Iron Ore Resources of the World.
Present Position of Cotton Cultivation.
Ceylon Mineral Survey.
Native Leather of West Africa.
Tobacco from the Transvaal.
Pigeon Peas from Sierra Leone.
Land for Rubber Cultivation in British Guiana.
Pecan Nuts.
Antiseptic Value of Cyprus Origanum Oil.

Colonial and Indian Collections:—

West Indian Court:—Windward Islands Exhibits.

Other Publications.

During the year the following publications have also been issued:—

Colonial Reports, Annual, No. 656. Report by the Director on the Work of the Imperial Institute, 1909. (Cd. 4964-30.)

Colonial Reports, Miscellaneous, No. 71. Selected Reports from the Scientific and Technical Department of the Imperial Institute. Edited by the Director. III.—Foodstuffs. (Cd. 5137.)

Colonial Reports, Miscellaneous, No. 74. Report on the Results of the Mineral Survey of Ceylon, 1906-7 and 1907-8. By Professor Dunstan. (Cd. 5390.)

Colonial Reports, Miscellaneous, No. 67. Report on the Results of the Mineral Survey of Southern Nigeria, 1905-6. By Professor Dunstan. (Cd. 4994.)

Colonial Reports, Miscellaneous, No. 68. Report on the Results of the Mineral Survey of Southern Nigeria, 1906-7. By Professor Dunstan. (Cd. 4995.)

Report on the Present Position of Cotton Cultivation. Presented to the International Congress of Tropical Agriculture, Brussels, May, 1910. By Professor Dunstan.

The following is a list of the principal papers contributed to scientific and technical Journals by members of the scientific staff of the Imperial Institute:—

"On Carnotite and an associated mineral complex from South Australia." By T. Crook and G. S. Blake. (Mineralogical Magazine, 1910, vol. 15, No. 71, pp. 271-284.)

"An Earthquake Model." By Dr. J. W. Evans. (Quarterly Journal of the Geological Society, 1910, Vol. 66, p. 246.)

"The Rocks and Minerals of Peninsular India." By Dr. J. W. Evans. (Proc. Geol. Assoc., 1910, Vol. 21, p. 448, with two folding stratigraphical tables.)

"The Constitution and Synthesis of Caoutchouc." By Dr. S. S. Pickles. (Journ. Chem. Soc., 1910, Vol. 97, p. 1085.)

VII.—SCIENTIFIC AND TECHNICAL DEPARTMENT.

A detailed account will be found in the succeeding pages of the work carried on in this Department during the year, partly in conducting investigations as to the composition and value of raw materials, mineral and vegetable, and partly in supplying information respecting the utilisation of such materials, and also their cultivation and production. The number of reports completed in 1910 was 504, and at the end of the year 203 investigations were in progress. Details respecting these investigations are given under the heading of the subjects to which they relate. The countries for which investigations have been conducted are:—

Bahamas, Bermuda, British Honduras, British North Borneo, British Guiana, Canada, Cape of Good Hope, Ceylon, Cyprus, Dominica, East Africa Protectorate, Falkland Islands, Federated Malay States and Straits Settlements, Fiji, Gambia, Gold Coast, Hong Kong, India, Jamaica, Mauritius, Natal, Newfoundland, New Zealand, Northern

Nigeria, Nyasaland, Orange River Colony, Queensland, Rhodesia, St. Helena, St. Vincent, Sarawak, Seychelles, Sierra Leone, South Australia, Southern Nigeria, Sudan, Tasmania, Transvaal, Trinidad, Uganda, Victoria, Wei-hai-wei, West Australia and Zanzibar.

Minerals.

Countries of Origin:—Cyprus, Uganda, East Africa Protectorate, Nyasaland, Rhodesia, Union of South Africa, Northern Nigeria, Southern Nigeria, Gold Coast, Sierra Leone, Gambia, Seychelles, Ceylon, India, Federated Malay States, Australian Commonwealth, New Zealand, Fiji, Falkland Islands, West Indies, Canada, United Kingdom and Foreign Countries.

Mineral Surveys.

The Mineral Surveys in Ceylon and Southern Nigeria were continued during the year and considerable progress was made in the examination of the minerals collected in connection with these two surveys and those for Northern Nigeria and Nyasaland.

Ceylon.—The Mineral Survey of this Island was commenced in 1903, and four reports on the results obtained have been published in the Miscellaneous Series of Colonial Reports. In 1910 the Director of the Imperial Institute visited Ceylon to arrange for the future organisation and work of the Survey, and to inspect a number of mineral localities. It has now been decided to continue the Mineral Survey and to develop its work so that the officers of the Survey may carry out prospecting operations on a larger scale than hitherto, and work was commenced on this plan towards the end of 1910, Mr. J. S. Coates, B.A. (Cantab.), being appointed Principal Surveyor and Mr. Paisley, Assistant Surveyor.

During the year the examination of the large number of minerals collected by the Surveyors in 1906-07, 1907-08 and 1908-09 was completed and the reports on these were published in October last in the Miscellaneous Series of Colonial Reports (Cd. 5390). The minerals dealt with in these reports are chiefly from the Southern, Eastern and Sabaragamuwa Provinces. They include many concentrates, prepared from alluvial deposits, and most of these were found to contain thorium-bearing minerals, though generally in too small amount to be worth working on a large scale. The results on the whole afford ground for the belief that more detailed investigation may reveal deposits of this character which will repay exploitation. The gravels of the Kuda Panda Oya, Bambarabotuwa, where the first and most important discovery of thorium-bearing minerals was made, have been systematically worked during the last few years, and are now believed to be largely exhausted. It has been found, however, that the deposit extends up the west side of the valley, and this is now being worked for thorianite. The latter mineral has also

been found *in situ* at Hiniduma Pattu in the Central Province in a pegmatoid rock largely composed of black mica. The variety of thorianite found at this locality contains 51·1 per cent. of thoria, and 24·9 per cent. of uranoso-uranic oxide, and can be worked at a profit. The occurrence is of special interest since it affords information as to the kind of rock with which thorianite is associated and with which it may be expected to occur in other localities. Further analyses of Ceylon monazite confirm the view that it is invariably richer in thoria than the Brazilian monazite of commerce. Certain of the concentrates examined contained tinstone and gold in addition to thorium minerals, and these occurrences are of importance in the alluvial deposits of Narawelpitiya and the Weralupedola, which, if further investigation proves them to be extensive, may be worth working.

Native copper has been found at Higgastenna, and chrome iron ore at Kondurugala, but not in amounts of any economic importance. An interesting occurrence is that of pyrrhotite containing cobalt, nickel, and traces of gold and platinum at Madugoda, in the Central Province. Considerable attention was also given by the officers of the Survey during this period to the mica and graphite mining industries of the island, and a number of occurrences of limestone were recorded. Most of these limestones contain magnesia, which renders them less suitable than pure limestone for making mortar, but may not impair their value for agricultural purposes. A number of samples of waters from mineral springs were collected and examined, and two of these proved to be sulphur waters, which may be of medicinal value. Detailed analyses of the minerals mentioned and others will be found in the report already alluded to (*loc. cit.*).

Considerable progress was also made during the year with the examination of the minerals collected during 1909-10, and a report on these is now in preparation.

Southern Nigeria.—The minerals received in connection with the Mineral Survey of this Colony in 1907-08 and 1908-09 were examined, and the report on those received in the former year was ready for publication at the end of 1910, and has since been issued in the Miscellaneous Series of Colonial Reports (Cd. 5517). It gives detailed descriptions and analyses of the minerals of economic importance collected, and notes on the geological structure of the districts examined. A number of occurrences of iron ore were noted, but analyses of samples from these deposits showed that they were on the whole too poor to be worth exporting, though some of them were suitable for smelting locally on a small scale by native methods. A phosphatic rock containing the equivalent of 23·2 per cent. of phosphoric anhydride was observed at Shabi Hill, and this occurrence deserves further investigation as a possible source of supply of phosphatic manure for local use in agriculture. The stream deposits in the areas visited were examined and a large number of concentrates prepared from them. Most of these contained a little monazite and a few tinstone and gold. The most promising results were obtained on the Oyan River, where at one point gold varying in value from 5·3*d.* to 20·8*d.* per cubic yard of gravel treated was

obtained by box-sluicing. The Principal Surveyor is of opinion that though the amount of auriferous gravel at this place is not large it would repay natives working on their own account.

In the " Report on the Work of the Imperial Institute for 1909 " [Cd. 4964-30], p. 16, reference was made to the receipt at the Imperial Institute for trial of several large consignments of lignite from the deposits of this fuel discovered by the Mineral Surveyors in Southern Nigeria. During 1910 briquetting trials were carried out in the United Kingdom and in Germany under the supervision of members of the Imperial Institute staff, and it was found possible to produce briquettes of excellent quality from this material. These briquettes have a calorific value but little inferior to that of some varieties of coal, are impermeable to water, and can be stored for long periods without disintegration. A consignment of these briquettes has been forwarded to West Africa for firing trials on locomotives. Information was also collected by the Imperial Institute on the lignite mining and briquetting industries of Germany and Bohemia, which were inspected by Professor Dunstan and Dr. Henry, and a report on the whole subject is now in preparation. During 1908-09 the officers of the Survey discovered large deposits of true coal in the Udi district of Southern Nigeria, and samples of this fuel are under investigation at the Imperial Institute. The Udi coal is however less conveniently situated for immediate development than the chief lignite deposits, which lie within a few miles of the Niger, and consequently it seems likely that the briquetted lignite may prove more economical as a fuel for present use in West Africa than Udi coal. In any case it is now clear that these discoveries will in the near future render unnecessary the heavy expenditure on imported coal that at present takes place from British West Africa, and that the use of local fuel will materially assist the development of all the West African Colonies.

Northern Nigeria.—Field work in connection with the Mineral Survey of this Protectorate terminated in 1909, and the examination of the minerals collected in 1908-09 was completed during 1910, and a report on this work is now in preparation.

Nyasaland.—A report on the results of the examination of the minerals collected during 1908-09, the last year in which field work was carried on in connection with the Mineral Survey of this Protectorate, is in preparation.

Anglo-Congolese Boundary Commission.—Final reports were made during the year on the minerals, collected by the Geologist appointed to accompany this Commission, which have been investigated at the Imperial Institute. These reports give results of analyses of the iron ore deposits found at Kazinga and Kiryama, and show that the Kiryama iron ore contains a notable quantity of manganese. Hæmatite of good quality was found at Kasindi. "Calc sinter " of good quality and suitable for the production of mortar was located at Bitentè Kamuri, and the lignite deposits at Engiti River were examined. This lignite is a poor quality and the amount available is probably small. Gold in small quantities was found in a number of the streams in the area

examined. An isolated block of pyrrhotite, a sample of which proved to contain about 9 per cent. of nickel, was found in the bed of the Soni River and may indicate the occurrence of deposits of similar material in that neighbourhood. At the conclusion of his work with the Boundary Commission, the Geologist was deputed to examine the area lying beween the western shore of Lake Albert and the boundary of the Belgian Congo. This proved to be poor in minerals of economic importance, but examination of the rocks collected proved that these contained small quantities of gold, and this metal was also found in concentrates prepared from alluvial deposits in this area.

The work done by the Geologist in connection with the Boundary Commission and afterwards was necessarily of a preliminary character only, and is chiefly interesting as affording useful indications of several directions in which further geological work in these areas may lead to results of economic importance.

General.

Cyprus.—A number of samples of asbestos were received and examined. Three of these proved to be of saleable quality and were valued at £7, £12, and £14 per ton. Specimens of puzzolana, soapstone and kaolin were also examined, but these were of poor quality. At the end of the year a small consignment of green pigment was under trial with a view to ascertaining whether this material would be saleable for the manufacture of paints and colours.

Uganda.—Reference has been made to the examination of a number of minerals and rocks from Uganda under surveys (see p. 17). In addition a number of samples of rocks, soils, native salts, spring waters, sands and other materials were examined. Two of the soils contained considerable quantities of alkali salts, and in connection with these and the other soils, recommendations were made as to the crops likely to do well on them. At the close of the year two soils were under examination.

East Africa Protectorate.—After concluding his work with the Anglo-Congolese Boundary Commission as described above, the Geologist to the Commission was deputed to examine certain areas in the East Africa Protectorate, and the minerals then collected were sent to the Imperial Institute for examination, and this work was completed during 1910. They included various samples of auriferous quartz and graphite, none of which was of economic importance. The examination of an extensive series of samples of "soda," alkaline liquors, spring waters and rocks from the "soda" lake at Magadi in East Africa was completed, and a report on this work is now in preparation. It supplements the information gained by the Company under whose auspices these soda deposits are now to be worked, and discusses the geological evidence available as to the original source of this immense deposit of "soda." The "soda" consists essentially of sodium sesquicarbonate, and merely requires heating to furnish commercial "soda" of good quality.

A number of rocks from East Africa were identified. Several soils have been completely analysed with a view to the determination of the manurial treatment they required for the cultivation of wheat. At the close of the year samples of soil and of diatomite remained under investigation.

Nyasaland.—The work done in connection with the Mineral Survey of this Protectorate is referred to on page 17 of this Report. In addition two samples of mica were examined. Both of these were of good quality and were valued at 3*s.* 6*d.* to 4*s.* per lb. and 3*s.* 3*d.* to 3*s.* 9*d.* per lb. respectively.

Rhodesia.—A series of samples of auriferous quartz from North-Eastern Rhodesia was examined. The four best of these yielded 5 oz. 10 dwt., 1 oz. 17 dwt., 1 oz. 8 dwt., and 1 oz. 3 dwt. of gold per ton. A second series of Rhodesian gold ores was under examination at the end of the year.

Union of South Africa.—From the Transvaal Province specimens of molybdenite, arseno-pyrite, verdite, tin ore, and various mining by-products were received. The tin ore was a complex product which yielded 43·18 per cent. of tin, 7·9 per cent. of arsenic and nearly 4 oz. of silver per ton. At the end of the year a concentrate recovered in the course of gold mining and a large proportion of osmiridium was under examination. For the Orange River Province a report was prepared on samples of sodium sulphate recovered from brine pans and a memorandum on the manufacture of alkali from sodium sulphate. From Natal Province a considerable number of samples were received for report. These included graphite, asbestos, tinstone, "supposed diamonds," zircons and columbite-tantalite. Enquiries relating to the use of basic slag and the grinding of mica were also dealt with. From Cape Province asbestos, umber and "nitre" were received. The "nitre" contained 95·4 per cent. of potassium nitrate and was valued by merchants at 15*s.* 6*d.* per cwt.

Northern Nigeria.—In addition to the work done in connection with the Mineral Survey and already alluded to (page 17), samples of native "potash," ironstone, water and various rock materials forwarded by Political Officers in the Protectorate were examined.

Southern Nigeria.—The work done in connection with the Mineral Survey of this Colony has been referred to already (page 16). The samples received independently of the Mineral Survey included about 150 specimens of borings from wells sunk in the course of a search for petroleum in the Colony. Samples of clays and limestones were also examined with a view to ascertaining whether they were suitable for the manufacture of cement. Specimens of rocks and sands were also received for identification.

Gold Coast.—An interesting specimen of quartz conglomerate was received. It contained 5·13 dwts. of gold per ton. Specimens of limestone and petroleum were submitted for examination towards the end of the year.

Sierra Leone.—The samples examined included auriferous quartz and monazite sand.

India.—A series of specimens of limestone, marl, and clay was received from India for cement-making trials, and this work was still in progress at the end of the year. Seven samples of asphalt from the island of Bahrein were also reported on. The best of these contained about 20 per cent. of bitumen in a limestone matrix. As a whole the samples represented material which if mined with care could be used to produce a standard paving asphalt.

A sample of the monazite sand recently discovered at Travancore was examined. The monazite present was isolated, and on analysis proved to contain about 10 per cent. of thoria, so that it appears to belong to the same type as the Ceylon monazite.

Other materials submitted for examination from India were lignite ash, Delhi pottery, "diamond conglomerate" and zinc dust.

Federated Malay States.—A sample of "wolfram ore" was found to contain 5·86 per cent. of stannic oxide, 26·15 per cent. of tungstic oxide, and to consist of a mixture of ilmenite, wolfram, tinstone, magnetite, and xenotine, and it was suggested that the valuable constituents could be isolated in merchantable form by a combination of magnetic and hydraulic methods of separation. The other minerals received for examination were nine specimens of "amang" (a by-product of tin-mining in the Malay Peninsula) and a tantalum mineral for identification, and analyses of these were in progress at the end of 1910.

Australian Commonwealth.—A number of interesting minerals were received from Australian States for investigation during the year. They included yttro-tantalite, containing 57·5 per cent. of tantalic acid, from South Australia, and a sample of amblygonite, containing 8·56 per cent. of lithia from Western Australia. Both these materials would be of commercial value if obtainable in quantity. Throughout the year an enquiry was in progress on the utilisation of Australian tantalite for the manufacture of tantalum-steel. A series of shales and limestones from Tasmania [illegible] examined. Analyses of a number of other Australian minerals were in progress at the end of the year.

Falkland Islands.—A hard jet-like bitumen was received from this Colony and examined. It gave results which indicated that it might be suitable for distillation for oil, and enquiry was made as to the quantity available. A mineral water and a sample of decomposed pyrites containing 68·4 per cent. of ferrous sulphate were also received.

West Indies.—From Trinidad samples of bitumen, "supposed graphite" and iron ore were received and examined and from the Bahamas a sample of marl. The Trinidad iron ore is probably of excellent quality and a report on this material was in preparation at the end of the year.

Canada.—The enquiries received included one on the grading of pebbles for use in tube mills, and a short memorandum giving particulars of the French and Danish trade in pebbles was supplied.

United Kingdom.—The samples received consisted mainly of minerals submitted for identification by firms trading in the United

Kingdom. A number of enquiries were also received from such firms generally with reference to the mineral resources of British Colonies or asking for information as to sources of supply of minerals used as industrial raw materials.

Foreign Countries.—These consisted for the most part of minerals submitted by British Consuls in foreign countries and included nearly 100 specimens forwarded by His Majesty's Consul at Fez. Among these were a number of minerals of economic value including galena, iron ore, cinnabar, stibnite, petroleum, &c., and complete analyses of the most promising of these were made. From Portuguese East Africa a complex gold ore was received containing nearly 7 oz. of gold per ton, as well as zinc, copper, lead, antimony and silver. Further enquiry however showed that supplies of the ore as rich in gold as this sample could not be depended on.

FIBRE (INCLUDING COTTON).

Countries of Origin.—Sudan, East Africa Protectorate, Uganda, Nyasaland, Rhodesia, Union of South Africa, Gold Coast, Sierra Leone, Southern Nigeria, Northern Nigeria, St. Helena, India, British North Borneo, Federated Malay States, Jamaica, British Honduras, Australia, Mozambique, Foreign Countries.

Cotton.

Sudan.—Samples of "Voltos" and "Nubari" cottons, grown at Zeidab, were of good quality and were respectively valued at 14¾*d.*-15*d.* per lb., with "good" Abassi at 15*d.* per lb., and 13¼*d.*-13½*d.* per lb., with "good" brown Egyptian at 13*d.* per lb. A specimen of Mitafifi cotton grown at Fadlab was valued at 13*d.*-13½*d.* per lb. on the same date.

Uganda.—Four samples were examined, one of which was of soft, long staple and was valued at 1*d.* per lb. in advance of "middling" American. A comparison of the cotton of Kampala with that of Buddu showed that the latter was much stained and decidedly inferior to the former. The samples were valued respectively at 0·7-0·8*d.* and 0·1-0·2*d.* in advance of "middling" American.

Nyasaland.—Seven samples of cotton and three of cotton seed were examined. The Egyptian cottons were generally somewhat inferior to standard specimens from Egypt, but the American cottons were of excellent quality, one sample being valued at as much as 2*d.*-2½*d.* per lb. in advance of "middling" American.

Rhodesia.—Six samples were examined and were of satisfactory quality, although the Egyptian kinds were not quite equal to standard specimens of the corresponding varieties grown in Egypt. A sample of American Upland was valued at 8*d.* per lb., with "middling" American at 7·36*d.* per lb.

Union of South Africa.—Three samples of "Caravonica" cotton grown in Zululand were of good quality. One of them was regarded as readily saleable as a substitute for rough Peruvian at 10¾*d.*-11*d.* per lb., with "good" moderately rough Peruvian at 10½*d.* per lb., whilst the others were less harsh and

were valued at about 12*d.* per lb. with " good " Abassi at 15*d.* per lb. A specimen of wild cotton from Zululand was strong, harsh, about an inch long, and worth about 7½*d.* per lb. with " middling " American at 8¼*d.* per lb.

Seven samples, including American, Egyptian, and Caravonica cottons from the Cape Province were all of promising quality. Those of the American type were valued at 5¾*d.*-6½*d.* per lb. with " middling " American at 5·72*d.* per lb., and the Caravonica cottons were regarded as worth 7¾*d.*-8*d.* per lb. on the same date.

British West Africa.—Eleven samples of cotton produced by hybrids grown at the Labolabo Plantation, Gold Coast, were all valued in advance of " middling " American. Some of them were rather harsh and might prove serviceable as substitutes for rough or semi-rough Peruvian. Four specimens of native cottons from the Northern Territories, Gold Coast, were of good, saleable quality, and were valued at from 6·70*d.* to 7*d.* per lb., with " middling " American at 6·39*d.* per lb.

Four samples of cotton from Southern Nigeria, which were probably all native varieties, were of satisfactory length but of poor quality, and had apparently suffered from the attack of insect pests. A specimen from Illushi was decidedly superior to most West African cottons, and was worth about 1*d.* per lb. in advance of " middling " American.

Two samples of native cottons from Northern Nigeria were much stained and of comparatively low value. These varieties, however, had a staple of about an inch, and would probably be capable of considerable improvement under cultivation.

India.—Ten samples of Egyptian and American cottons from Burma were of fairly good quality, but inferior to standard commercial specimens.

British Honduras.—A sample of long-stapled Upland cotton was regarded as of the same value as " fully good fair " Abassi (13¾*d.* per lb.). A hybrid cotton, also of long staple, was valued at 12½*d.*-13*d.* per lb. on the same date.

Foreign Countries.—Twenty-one samples of improved American Upland cottons from Mozambique were examined. Four of them were of short staple and were valued at about 7½*d.* per lb., but the others were of good length and useful spinning quality, and ranged in value from 7⅞*d.* to 9*d.* per lb., with " middling " American at 7·59*d.* per lb. A sample of " Caravonica " cotton was of very poor quality and nominally worth 5¾*d.*-6*d.* per lb.

Jute and Similar Fibres.

Rhodesia.—A sample of bast fibre, probably derived from *Hibiscus* sp. resembled jute in general appearance, but was slightly coarser. It was of good strength but was rather short and somewhat imperfectly cleaned. The product was valued at £18 per ton, with " first native marks " Calcutta jute at £21 10*s.* per ton.

Union of South Africa.—A specimen of the fibrous bark of *Pavonia mollis* from Natal appeared to contain a jute-like fibre.

It was suggested that a sample of the fibre should be carefully prepared by retting and forwarded for examination.

British West Africa.—A specimen of "Ramma" fibre (*Hibiscus cannabinus*) was of good length and strength and was valued at £16-£17 per ton, with "first native marks" Calcutta jute at £14 7*s.* 6*d.* per ton. Such fibre would be readily saleable as a substitute for jute. Another sample of fibre, probably of the same botanical origin, was rather shorter and not quite so well prepared, and was regarded as worth about £14 per ton, when "first native marks" Calcutta jute was quoted at £17 per ton.

India.—Two samples of jute from Bombay were of good strength but only about 3 feet long. One of them was unevenly prepared and the root ends had not been cut off whilst the other had been batched, softened and carded. The fibres were valued at £12 and £14 per ton respectively, with "first native marks" Calcutta jute at £14 per ton.

Fibres Suitable for Cordage Manufacture.

Uganda.—A sample of "Kafu bo" fibre (*Asclepias semilunata*) resembled specimens examined previously, but was softer and less gummy. Unfortunately, the yield per acre of this excellent fibre is so small as to render it doubtful whether its cultivation and preparation would be remunerative.

St. Helena.—A sample of *Phormium tenax* fibre resembled previous specimens and was of approximately the same strength.

India.—Three samples of plantain fibre from Burma were clean and lustrous but weak and brittle. They were much inferior to Manila hemp both physically and chemically. The fibres were regarded as worth about £13-£14 per ton, with "good current" Manila hemp at £34-£34 10*s.*, and "good seconds" at £23 15*s.*-£25 15*s.* per ton.

Three specimens of fibre, grown near Cawnpore, and derived respectively from *Agave sisalana*, *A. Mexicana*, and an *Agave* of unknown species, were white, lustrous, well prepared and strong, and were valued at prices ranging from £28 to £31 per ton, with best Mexican sisal at £29 per ton.

A sample of *Crotalaria juncea* fibre from Bombay had not been satisfactorily prepared, was of uneven length and strength, and was inferior to ordinary Bengal Sunn hemp. It was valued at £14 per ton (May, 1910).

Flax.

East Africa Protectorate.—Two samples of flax, grown at the Kabete Farm, were examined. One of them was somewhat brittle and lacked flexibility owing to the gummy matter not having been completely removed, but was of a promising character, and was regarded as worth about £30 per ton. The other specimen was soft, towy, and of uneven strength, and was valued at £18 per ton (July, 1910).

Silk.

British West Africa.—A small consignment of native silk from Southern Nigeria consisted of aggregations of cocoons of *Anaphe* sp. The material was dirty and, when degummed, yielded silk

of poor strength and quality. This product could not be reeled but might possibly be utilised as "spun silk."

Seven samples of *Anaphe* silk were received from Northern Nigeria. Two of them were of good quality and would be serviceable as a substitute for "tussar" silk, whilst the others were of inferior quality.

Natal.—A sample of *Anaphe* silk was found to be very weak and brittle.

India.—Two samples of mulberry silk from Eastern Bengal and Assam were of promising quality, and were valued at 11*s.* and 8*s.* per lb. respectively (November, 1910).

Paper-Making Materials.

Sudan.—A sample of papyrus, from the mouth of the Bahr el Gebel, gave a yield of paper-pulp about equal to that furnished by a specimen of esparto grass treated in the same way. The pulp was of satisfactory quality and consisted of fibres of about the same length as those of esparto grass pulp. It was considered unlikely that the papyrus could be profitably exported as the air-dried material would not realise more than about £3 per ton in the United Kingdom, and it was suggested that it would be better to convert the material into half-stuff locally and export the latter.

East Africa Protectorate.—A sample of papyrus was examined with results similar to those obtained with the Sudan product.

Union of South Africa.—A sample of Spanish reeds (*Arundo Donax*) from the Transvaal furnished a satisfactory yield of paper pulp of fairly good quality. As the raw material would not be worth more than £3 per ton in the United Kingdom, it is improbable that it could be profitably exported, but it was suggested that it might be worth while to convert it into pulp in the Transvaal, and either export the latter or make it into paper for local use.

Four samples of pulp from Natal made from the wood of *Acacia mollissima* were examined. The pulp was of poor quality, being composed of very short fibres. Such a product would have to compete with a waste material which can be purchased at £2 per ton.

India.—An investigation was made of the suitability for paper-making of jute stems from which the bast fibre had been stripped. The results showed that the pulp was composed of very short fibres and would consequently be of little value.

Among other products examined as possible paper-making materials may be mentioned the fibre and petiole of the Nipa palm from the Federated Malay States, palm leaves from British North Borneo, the trunk and leaf-bases of *Xanthorrhœa Preissii* from Western Australia, leaves of *Bromelia* sp. from Brazil, and several varieties of reeds from Persia.

Miscellaneous.

Various other fibrous materials were examined among which may be mentioned the stems of *Cyperus Fischerianus* from the East Africa Protectorate, a sample of coir from the Gold Coast; fibres of *Cryptolepis Buchanani* and *Dregea* sp. from India; and the fibre of *Posidonia australis* from Australia.

Numerous enquiries were dealt with relating to the identification, cultivation, preparation, utilisation and exploitation of various fibres, requests for information being received from merchants and manufacturers in the United Kingdom as well as from planters and others in the Colonies.

Rubber.

Countries of Origin:—Ceylon, India, Straits Settlements, Federated Malay States, Borneo, Gold Coast, Southern Nigeria, Sudan, Zanzibar, Nyasaland, Rhodesia, Union of South Africa, Bahamas.

Ceylon.—A specimen of Ceara rubber submitted for examination consisted of light-brown sheets which were clean and well-prepared. The rubber contained 91·3 per cent. of caoutchouc and was of satisfactory composition, except that the amount of ash, 1·3 per cent. was unusually high. The sample was of good quality and its value was placed at probably about 8*s.* per lb. in London, with fine hard Para at 10*s.* per lb., and good to fine plantation Para biscuits at 8*s.* 10½*d.* to 9*s.* per lb.

India.—The coagulated latex of a species of fig growing in the Himalayas was of very resinous character, and would consequently have little, if any, commercial value.

Straits Settlements.—A further sample of smoked Para rubber, prepared by the Brazilian process, was examined for comparison with the previous specimens analysed in 1909. The amount of resin in the dry rubber, as determined by the usual process, was found to amount to 4·8 per cent., compared with 5·2 per cent. in the earlier samples. These percentages of resin are very high for Para rubber of good quality. Further examination showed however that a quantity of a crystalline substance soluble in hot water was removed from the rubber with the resin, and in order to investigate the occurrence of this substance, samples of the latex of the tree furnishing the rubber were requested. The investigation of the latex was still in progress at the end of the year.

Federated Malay States.—Two samples of Para rubber, taken from commercial consignments which had become sticky during transit, were examined in order to ascertain whether any change in composition had occurred. The sticky rubber was found to contain nearly three times as much resin as the non-sticky portions.

Borneo.—Samples of crêpe and ball rubber, stated to have been prepared from Gutta Jelutong, were examined, together with a slice of block rubber supposed to be of similar origin. The sample of crêpe rubber was insufficient for complete analysis; it was rather soft and weak, and contained over 13 per cent. of resin. The ball rubber, which was soft and sticky, contained 76 per cent. of caoutchouc and 11 per cent. of ash. The specimen of block rubber was rather weak, but contained nearly 92 per cent. of caoutchouc.

Gold Coast.—Two samples of *Funtumia elastica* rubber, prepared by boiling the diluted latex, consisted of biscuits and thin sheets of light-brown rubber marked by dark patches. The

material was clean and well-prepared, and exhibited good elasticity and tenacity. One sample, representing the rubber which coagulated first on boiling, contained 90·5 per cent. of caoutchouc and 7·1 per cent. of resin in the dry material, whilst the other sample, the portion which coagulated last, contained 88·5 per cent. of caoutchouc and 9·2 per cent. of resin. The rubber was valued at 6*s.* to 6*s.* 6*d.* per lb., with fine hard Para at 7*s.* 7*d.* per lb., and Ashanti lump rubber at 1*s.* 11*d.* to 2*s.* 3*d.* per lb.

Two samples of *Ficus Vogelii* ("Memluku") rubber were found to be of resinous nature and deficient in elasticity and tenacity. They contained 66·2 and 65·5 per cent. of caoutchouc respectively, with 31·6 and 30·9 per cent. of resin. The rubber was submitted for technical trial to manufacturers, who reported that it was soft and of inferior quality, and valued it at about one-fifth of the price of washed Para rubber.

Southern Nigeria.—Samples of Para rubber (*Hevea brasiliensis*) forwarded from Ebute Metta consisted of light-coloured, well-prepared biscuits, free from impurity, and exhibiting excellent physical properties. The first sample contained 95·8 per cent. of caoutchouc and only 1·7 per cent of resin, expressed on the dry material, whilst the second contained 92·8 per cent. of caoutchouc and 5 per cent. of resin. The samples were valued in London at 9*s.* and 8*s.* 10*d.* per lb. respectively, with fine hard Para at 9*s.* 10*d.* per lb.

A consignment of about 30 lb. of Para rubber from Orugbo consisted of light-brown, well-prepared biscuits exhibiting very good physical properties but of rough appearance. A sample was analysed and found to contain over 94 per cent. of caoutchouc, expressed on the dry material, and only small amounts of resin and proteid. In composition the material was equal to plantation Para rubber from the East, but the biscuits as received contained a larger percentage of moisture than is usually present in plantation rubber. The consignment was sold in London at 8*s.* 10½*d.* per lb., with fine hard Para at 9*s.* 10*d.* per lb. This price must be considered very satisfactory for such a small consignment.

A sample of Para rubber prepared at Calabar by boiling the latex consisted of two small pieces of light-brown rubber, one of which exhibited good physical properties whilst the other was weak. The chemical composition of the rubber was satisfactory, the dry material containing over 93 per cent. of caoutchouc, and consignments similar to the stronger piece would be worth about 7*s.* 6*d.* per lb. in London with fine hard Para at 10*s.* per lb. If carefully prepared without the application of heat this rubber would be of satisfactory quality and would realise a good price.

A sample of supposed Landolphia rubber from Calabar consisted of twelve small pieces of light-brown rubber exhibiting very good physical properties. The composition was very satisfactory, the dry rubber containing over 94 per cent. of caoutchouc with only very small amounts of resin and proteid. The rubber was worth about 7*s.* per lb. in London with fine hard Para at 10*s.* per lb.

A sample of *Funtumia elastica* rubber, prepared at Olokomeji by boiling the latex, consisted of light-brown biscuits which were of rather rough appearance, but exhibited very good phy-

sical properties. The dry rubber contained over 88 per cent. of caoutchouc, but the resin present amounted to 9 per cent. The sample was valued at 8*s*. per lb. in London, with fine hard Para at 10*s*. 6*d*. per lb. and Lagos and Benin lump rubber (selected) at 4*s*. 11*d*. to 5*s*. 3*d*. per lb.

Another sample of *Funtumia elastica* rubber, prepared at Calabar by boiling the latex, consisted of a large thin sheet possessing fairly good elasticity and tenacity, but sticky externally and therefore unsuitable for valuation. The dry rubber contained over 87 per cent. of caoutchouc, but the proportion of resin was rather high, amounting to 10·3 per cent. The stickiness of the sample was apparently due to overheating.

The latex of *Mimusops multinervis* was found to yield on coagulation a sticky product which became hard and brittle on standing. This brittle substance contained 66 per cent. of resin and 29 per cent. of a somewhat friable gutta-like material, which softened and became plastic on warming. On account of its brittle character the product does not appear likely to be of commercial value.

Sudan.—A sample of Ceara rubber from two-year old trees at Mongalla consisted of pale yellow biscuits exhibiting good elasticity and tenacity. The dry rubber contained nearly 82 per cent. of caoutchouc. The sample was valued at 4*s*. 10*d*. per lb., with fine hard Para at 5*s*. 10*d*. and good to fine plantation Para biscuits at 5*s*. 1*d*. to 5*s*. 4½*d*. per lb. This rubber was of very good quality and quite equal in preparation to any Ceara rubber on the London market. The results of the investigation are very promising, and indicate that the Ceara trees at Mongalla may be expected to furnish rubber of very good quality.

A consignment of rubber, derived from the indigenous rubber vine *Landolphia owariensis* var. *tomentella* growing in the Bahr-el-Ghazal, was forwarded for sale in London. It consisted of about 650 lb. of biscuits and sheet varying in colour from pale to dark brown, with a very small quantity of scrap rubber. An examination of representative samples of light and dark biscuits showed that the chemical composition of the rubber was very good, the percentage of caoutchouc varying from 92·7 to 93·6 in the dry material. The consignment was sold at public auction and realised prices ranging from 6*s*. 9*d*. to 8*s*. 4*d*. per lb., except in the case of the scrap rubber which was sold at 3*s*. 6*d*. per lb.; the current price of fine hard Para was 10*s*. 4*d*. per lb. The brokers reported that the rubber was exceptionally strong, and that with a little more care in preparation it should realise prices comparing favourably with those of Eastern plantation rubbers.

Uganda.—A sample of Ceara rubber coagulated with lime juice consisted of thin biscuits of uniform pale yellow colour. The rubber was excellently prepared and exhibited very satisfactory physical properties. The dry material contained 76·5 per cent. of caoutchouc, but the amounts of resin, proteid and ash were somewhat excessive, the proteid amounting to over 12 per cent.

The rubber was valued at 8*s*. 2*d*. to 8*s*. 4*d*. per lb. with fine hard Para at 10*s*. 1*d*. per lb. and good to fine Para biscuits at 8*s*. 10½*d*. to 9*s*. per lb. It was suggested that a specimen of the

rubber, prepared by simply diluting the latex with water and allowing it to stand, should be forwarded for examination in comparison with the above sample.

Nyasaland.—A sample of Ceara rubber obtained by the "pricking" method from two-year old trees consisted of very small balls of light-brown rubber which exhibited fair elasticity and tenacity. The dry rubber contained only 78·6 per cent. of caoutchouc, with 10·8 per cent. of resin, 8·4 per cent. of proteid and 2·2 per cent. of ash. The large percentage of resin is however not surprising in rubber from trees only two years old. The sample was valued at about 5*s.* per lb. in London, with fine hard Para at 10*s.* 6*d.* per lb.

Rhodesia.—Two samples of rubber from the Barotse District had apparently been prepared by beating the bark of the plant, as they contained respectively 22 and 32 per cent. of vegetable impurity. The rubber was however of satisfactory composition, and if prepared in a clean condition would be of good quality.

Two samples of "Muliya rubber" (*Diplorhynchus* sp.) from the Barotse Valley consisted of moist, sticky, resinous material exhibiting very little elasticity or tenacity. The samples contained, respectively, 29 and 17 per cent. of "caoutchouc" and 60 and 55 per cent. of resin, expressed on the dry material. The "caoutchouc" was a rubber-like substance exhibiting poor physical properties. Material of the kind represented by these samples would have little or no commercial value.

A sample of Ceara rubber appeared to be of promising quality, but was too small for chemical examination or trustworthy valuation.

Two specimens of latex were found to yield resinous products, which would have little if any commercial value.

Union of South Africa.—A sample of native Landolphia (?) rubber from the Northern Transvaal possessed good physical properties and was of very fair quality, the dry material containing 86 per cent. of caoutchouc. It was valued at 4*s.* 6*d.* per lb. with fine hard Para at 7*s.* 7*d.* per lb. Consignments of rubber of similar quality would be readily saleable.

A sample of so-called "balata" from Natal was found to contain 44 per cent. of resin and 48 per cent. of "caoutchouc" in the dry material. The product would therefore be classed as a very inferior rubber.

The latex of a species of Euphorbia from the Cape Province furnished on coagulation a soft sticky material, which, like the products of other South African Euphorbias previously examined, was of no commercial value.

During the year the South African Government were furnished with information as to the best methods of obtaining rubber from vines, and with particulars of suitable machinery for the extraction of rubber from bark.

Bahamas.—A sample of *Cryptostegia* rubber was too small for chemical examination, but its physical properties were satisfactory, and it was evidently of good quality.

The young stems of *Cryptostegia grandiflora* were found after drying to yield only 1 per cent. of rubber substance. The material obtained was of inferior quality, and it was clear that

such stems could not be profitably utilised as a source of rubber, though possibly much older stems would yield a better result.

Miscellaneous.—In addition to replies to numerous minor enquiries on the subject of rubber, a large amount of information relating to the cultivation and exploitation of rubber-yielding plants was furnished to Colonial Governments, British firms, and planters in the various tropical Colonies and Protectorates.

Oils and Oil Seeds.

Countries of Origin.—Sudan, East Africa Protectorate, Uganda, Nyasaland, Rhodesia, Gambia, Gold Coast, Sierra Leone, Southern Nigeria, Northern Nigeria, India, British Honduras, Fiji, and Foreign Countries.

"Baco" or "Abaku" seeds (Mimusops Djave ?).—The kernels from a sample of these seeds from the Gold Coast yielded 60·5 per cent. of a white, solid fat which was regarded by experts as of about the same value as medium qualities of palm-oil for soap-making. The dried kernels would be worth about £13 10*s.* per ton (February, 1910).

A specimen of *Mimusops* seed was also received from Southern Nigeria.

Beeswax.—A sample of beeswax from Uganda was of good quality and worth £6 17*s.* 6*d.* per cwt. (6th January, 1910).

Ben Oil Seeds (Moringa pterygosperma).—A small consignment of ben oil seed from Northern Nigeria was expressed by machinery. The oil was tested by manufacturers, who reported that it was suitable for soap-making, and for this purpose would be worth a little less than cotton-seed oil. It is now being subjected to a prolonged trial by a chronometer maker in order to determine its value as a lubricant. The oil-cake, on analysis, compared favourably with cotton cake and linseed cake with respect to its nutritive constituents, but unfortunately it has a bitter taste, and for this reason would probably be unsuitable for use as a feeding stuff and could only be employed as a manure.

Castor Oil Seeds.—A sample of castor oil seed from Rhodesia contained 52·2 per cent. of oil, and was valued by manufacturers at £13 per ton (June, 1910).

A sample from the East Africa Protectorate yielded 51·6 per cent. of oil, and was regarded as of about the same value as Bombay castor oil seed which was then quoted at £13 5*s.* per ton (October, 1910).

Copra and Coconut Oil.—Two samples of copra from the Gold Coast were examined. One was of fair quality and was valued at £19 per ton (December, 1910), but the other was in poor condition and worth only about £14 per ton.

A specimen of copra from Southern Nigeria was equal in appearance to Ceylon copra, but yielded an oil which was more acid than that from the latter. It was stated to be worth £19 per ton (June, 1910).

A sample of coconut oil from Southern Nigeria was of the usual character, and such oil, if quite clean, would be readily saleable at the current market price.

Cotton Seed Oil.—A study was made of the suitability of Indian cotton-seed oil for edible use, with special reference to its employment as a ghi substitute. It was found that the chemical and physical constants of refined oil from Indian seed are practically identical with those of refined Egyptian cotton-seed oil, and no difference in taste could be detected. A firm of manufacturers stated that the Indian oil is regarded as inferior to Egyptian for edible purposes on account of its "bloom" or fluorescent appearance.

Croton Seeds.—A small sample of *Croton Tiglium* seeds from Nyasaland was examined. The kernels yielded 58 per cent. of oil which possessed the usual properties of croton oil. It was reported that croton seed is in small but regular demand at 40*s.*-50*s.* per cwt. (February, 1910).

Ground Nuts.—A sample of ground nuts from Fiji was of excellent quality and valued at £13 10*s.* to £14 per ton.

Two samples of ground nuts from the Gambia were also examined.

Niger Seed (*Guizotia oleifera*).—A specimen of Niger seed from the East Africa Protectorate contained 37·6 per cent. of oil. This oil is serviceable as a substitute for linseed oil for soap-making, and would be worth 36*s.*-38*s.* per quarter of 416 lb. (September, 1909).

Oil-palm Products.—The investigation which was in progress during 1909 of the products of the different varieties of the West African oil-palm was completed. Numerous samples of palm fruits, palm kernels, palm oils, and palm kernel oils from the Gold Coast, Sierra Leone and Southern Nigeria were examined, and the results have been included in an exhaustive article published in the *Bulletin of the Imperial Institute*, Vol. VII., p. 357, which also contains suggestions for the improvement of the oil-palm industries of West Africa.

Specimens of palm-fruits from Nyasaland and Uganda were also examined.

Among other products examined may be mentioned Ceara rubber seed from Uganda, seeds of *Trichilia emetica* from Nyasaland, "benni" seeds (sesame) from Northern Nigeria, seeds of *Calophyllum Wightianum* from India, and M'fucuta seed from Mozambique.

A large number of enquiries were received from merchants, manufacturers and others with reference to the cultivation, production, and export of various oil-seeds, as well as to the properties of the different oils, and the machinery employed in their manufacture. Several specimens were received for identification.

Volatile Oils.

Countries of Origin:—Cyprus, Sudan, Uganda, East Africa Protectorate, Union of South Africa, Northern Nigeria, Gold Coast, Seychelles, Ceylon, India, Hong Kong, Fiji, West Indies, United Kingdom, Foreign Countries.

Cyprus.—In connection with the sale of various consignments of Cyprus origanum oil in the United Kingdom, eight samples of this oil were examined during the year. They were with one

exception of good quality and contained from 79·5 to 81·6 per cent. (by volume) of phenols, almost entirely carvacrol. The prices obtained varied from 3*s*. 1*d*. to 4*s*. 3*d*. per lb., the value of this oil fluctuating in sympathy with that of thymol. Samples of "mint," sage, and myrtle oils were also reported on during the year. The myrtle oil was of normal quality, but unfortunately the demand for this oil is small and there seems to be little chance of finding a market for it in the United Kingdom. The sage oil somewhat resembled Spanish sage oil, and was valued at 1*s*. 3*d*. to 1*s*. 4*d*. per lb. in London. The "mint" oil did not resemble any commercial oil, and a further examination of this material, botanically and chemically, will be needed before its value, if any, can be determined.

Sudan.—Specimens of *Cymbopogon Iwarancusa* and *Ocimum basilicum* were received for investigation. From the former an oil quite different from oils of the Cymbopogon type was obtained, and this requires further investigation to determine its value. The Sudan "basil" is still under examination.

Uganda.—In the previous report [Cd. 4964-30], p. 32, of this series, mention was made of the successful introduction into commerce of lemongrass oil from Uganda, and during the present year two more consignments were sold in London at good prices. The cultivation and distillation of lemongrass in Uganda is now securely established, and the industry has been handed over for development by private enterprise. Further supplies of *Chlorocodon Whiteii* root were under examination at the close of the year. This root contains a crystalline aromatic substance whose odour recalls that of heliotropin and vanillin.

East Africa Protectorate.—Samples of the twigs, branches and sapwood of the so-called "camphor tree" of this Protectorate were examined during the year. The materials yielded 0·14 to 0·52 per cent. of a volatile oil containing cineol, and it is to this oil that the camphoraceous aroma of the wood is due. The wood is of no value as a source of volatile oil.

Two samples of wood and bark from an unidentified plant were examined and shown to contain the same aromatic substance as is present in the Chlorocodon root of Uganda (see above).

Union of South Africa.—From the Transvaal Province a sample of "Sherungulu" tubers was received. This contained a small quantity of volatile oil and an additional supply has been requested for further examination.

Northern Nigeria.—The root of *Securidaca pedunculata* was examined and found to contain saponin and a small amount of methyl salicylate (wintergreen oil).

Gold Coast Colony.—Specimens of the leaves and twigs of the camphor tree, grown experimentally in this Colony, were found to contain 1·21 per cent. of dry camphor and 2·01 per cent. of total volatile oil, including camphor, whilst a sample of crude camphor prepared locally was found to contain 68·6 per cent. of dry camphor. These results indicate that this tree gives normal yields of camphor in the Gold Coast.

Sierra Leone.—A quantity of the volatile oil of the so-called Mosquito plant (*Ocimum viride*) was received and is still under investigation. As stated in the report for 1909, this oil contains

thymol, but it does not seem likely that it can be used as a commercial source of this product.

Seychelles.—A sample of ylang-ylang oil was received and examined, and a small consignment of vetiver roots was under investigation at the close of the year.

Ceylon.—An interesting series of Andropogon (*Cymbopogon*) oils and botanical specimens of the grasses yielding them was received from Ceylon, prepared by Mr. Jowitt of Bandarawela. It comprised 34 citronella oils, 5 lemongrass oils, and 4 oils distilled from *C. polyneuros*. The citronella grasses of Ceylon may be divided into three classes: "mana," "lena-batu," and "maha-pengiri," the first being wild, the second that generally cultivated and used by the natives for the distillation of Ceylon citronella oil, and the last that used by European firms for the production of a fine quality of citronella oil. Mr. Jowitt's herbarium specimens were examined at Kew and classified as follows:—The "mana" grasses were divided into two groups which were named *Cymbopogon Nardus* var. *Linnæi* (typicus), and *C. Nardus* var. *confertiflorus*. The "lena-batu" grass was named *Cymbopogon nardus*, Rendle, "Lena-batu," and the "maha-pengiri" grass *C. Winterianus*. The last-named grass appears to be identical with that cultivated in Java for the production of citronella oil.

The aroma of citronella oil depends on the presence of two constituents—geraniol and citronellal—and the relative amounts of these two constituents determine the character of the oil. Thus the Ceylon oil in general is rich in geraniol, whilst the best Ceylon oil and the Java oil are rich in citronellal. Mr. Jowitt's oils fall into two groups of this kind, one being rich in citronellal and the other rich in geraniol. The first group includes "maha-pengiri" oil and certain of the "mana" grass oils, whilst the second group includes the "lena-batu" oil and the remaining "mana" grass oils. Unfortunately this division of the "mana" grass oils into those rich in geraniol and those rich in citronellal does not quite correspond with the two groups into which these grasses are divided botanically, but this apparent discrepancy between the chemical and botanical results may be due to secondary causes, which further investigation will disclose. From a commercial point of view these results are of interest as showing that the mana grasses give, on the whole, small yields of oil of poor quality, and that consequently they are of little value for commercial purposes in comparison with the two cultivated varieties now grown in Ceylon for the production of oil.

The lemongrass oils received represented the commercial types of this oil, viz., "soluble" and "insoluble" in 70 per cent. alcohol, and were of normal quality. The *Cymbopogon polyneuros* oils differ entirely from any of the known Cymbopogon oils in character, and they are being further examined.

India.—A sample of lemongrass oil which was of the "insoluble" type, but contained 82·5 per cent. of aldehydes was reported on, and since then a small trial consignment of similar oil has been forwarded to London for sale.

Further information was collected and transmitted to the Government of Mysore on the subject of the markets for sandalwood in Europe and the United States.

Information was also supplied on methods of valuing turpentine oil with special reference to Indian turpentine oil, and a preliminary report was made on the oil from the wood of *Cinnamomum glanduliferum*. At the close of the year samples of turpentine and lemongrass oils were under examination.

Hong Kong.—A sample of peppermint oil distilled in China was received for examination from Hong Kong. It proved to be of very good quality containing 61·84 per cent. of menthol, of which 47·5 per cent. was present in the free state. The oil was valued at 5*s.* 2*d.* to 5*s.* 3*d.* per lb.

Fiji.—Samples of vetiver, "bay" and "lemongrass" oils were examined. The first of these was of very good quality, and would be saleable in the United Kingdom. The "bay" oil was of abnormal character, and requires further examination. The so-called "lemongrass" oil proved on investigation to be the product of *Cymbopogon coloratus*, a species not hitherto used for the production of essential oil. The oil differs considerably in character from citronella and lemongrass oils but has certain advantages as a perfume for soap, which may lead to its finding a market if it can be produced cheaply in quantity. It has been valued provisionally at 1*s.* 9*d.* to 2*s.* per lb.

West Indies.—A series of citrus oils from Dominica was examined. Several of these were of promising quality, particularly an orange-rind oil which was valued at 7*s.* 6*d.* to 8*s.* per lb. in the United Kingdom.

Foods and Spices.

Countries of Origin:—India, Ceylon, Nyasaland, East Africa Protectorate, Rhodesia, Natal, Southern Nigeria, Northern Nigeria, Gold Coast, Sierra Leone, Gambia, British Honduras.

Cereals.

Wheat.—In continuation of previous investigations an examination was made of several samples of wheat from the East Africa Protectorate and two samples from Northern Nigeria. The wheats were of excellent quality and would be readily saleable in the United Kingdom. The East African wheats were valued in London at 37*s.* to 38*s.* per quarter, and those from Northern Nigeria at 36*s.* 6*d.* and 37*s.* 6*d.* per quarter.

Maize.—Samples of yellow "Canary" and white "Lagos" maize, forwarded from the Gambia, were rather shrivelled and slightly attacked by weevils, but otherwise the general condition was good. They were valued in Liverpool at 5*s.* 6½*d.* per cental of 100 lb., whilst in London the value of the yellow maize was quoted at 25*s.* 6*d.*, and that of the white at 23*s.* 6*d.* to 24*s.* per quarter of 480 lb.

Miscellaneous.—A sample of guinea corn from Northern Nigeria was valued at 23*s.* per quarter. Samples of rice were received from Northern Nigeria and from Nyasaland, husked rice from the latter country being valued at 8*s.* to 8*s.* 6*d.* per cwt.

Leguminous Seeds.

A number of samples of beans of different varieties from the East Africa Protectorate were analysed and valued. Most of them would be readily saleable in the United Kingdom, and others on the Continent or in South Africa. The valuations varied from £5 to £6 5*s*. per ton in the case of varieties suitable mainly for feeding purposes for cattle whilst others suitable for human consumption were valued at higher prices, in some cases as much as £13 to £15 per ton. Several varieties of beans from Southern Nigeria were found to be suitable for feeding animals or for human food. "Florida" beans from Nyasaland were valued at £5 5*s*. per ton, and pigeon peas from Sierra Leone at £4 to £5 per ton. A sample of "sword beans" (*Canavalia* sp.) was received from British Honduras. These beans are not known at present on the London market, and a trial consignment has therefore been requested from the Colony.

Tea, Coffee, and Cocoa.

Four samples of tea from Natal appeared to have been satisfactorily fired, and gave liquors of useful colour though soft and dull in taste. The samples were valued at 7¼*d*. to 8½*d*. per lb., in London.

Eleven samples of coffee of promising quality from Rhodesia were valued, with the exception of one sample, at prices varying from 42*s*. to 47*s*. per cwt. These samples had been prepared by hand, and much better prices will doubtless be obtainable when more efficient methods of pulping, cleaning, and grading are introduced.

Samples of "clayed" and "unclayed" cocoa beans from the Gold Coast were of good quality and were valued at 51*s*. per cwt. The "claying" was however considered to be disadvantageous. Cocoa beans from Sierra Leone, of good fair quality, but rather "slaty," were valued at 46*s*. to 47*s*. 6*d*. per cwt. Seven samples of cocoa from San Thomé were analysed and submitted to experts, who valued five of them at 47*s*. 6*d*. per cwt., and the remainder at 48*s*. per cwt.

Miscellaneous Foodstuffs.

The first samples of grape fruit forwarded from the East Africa Protectorate to the United Kingdom were received at the Imperial Institute during the year. Commercial experts reported that the fruit was in practically perfect condition and of excellent quality, and stated that if similar fruit could be shipped to the United Kingdom during July and August it would find a ready sale at 15*s*. to 20*s*. per case, the price depending on the size of the fruits. At other periods of the year 10*s*. to 14*s*. per case should be realised in competition with grape fruit from Jamaica and California.

The leaves and stems of millet and guinea corn from Northern Nigeria were examined in connection with an investigation into their alleged poisonous properties. The guinea corn gave a negative result, and though traces of prussic acid were found in the millet the quantity was too small to be injurious to cattle. Further samples of these plants at different stages of growth have been requested.

In addition to the examination and valuation of samples, many enquiries as to the cultivation and marketing of foodstuffs were received during the year from both official and private sources. Among other replies to such enquiries, information was furnished to the authorities in Rhodesia regarding plants likely to be useful as vegetables in preventing scurvy, whilst the Tasmanian Government was supplied with memoranda on beet cultivation and the extraction of beet-sugar, and on the manufacture of starch and alcohol from potatoes. At the end of the year investigations were in progress regarding samples of beans and wheat from the East Africa Protectorate, rice from British Honduras and arrowroot from Bermuda.

Spices.

Dill fruits received from the East Africa Protectorate were found to give an average yield of oil of good quality, and one sample of the fruits was provisionally valued early in the year at 18*s.* to 22*s.* per cwt., whilst another was valued some time later by two commercial experts at 27*s.* and 34*s.* per cwt. respectively. Coriander from the East Africa Protectorate was also examined during the year. A sample of allspice from the Gold Coast was provisionally valued at $2\frac{1}{16}d.$ to $2\frac{3}{8}d.$ per lb., and a further supply was requested for more definite valuation. Nutmegs from Mauritius were valued at $3\frac{1}{4}d.$ to 5*d.* per lb., according to size, and a sample of mace from the same Colony was valued at 1*s.* 10*d.* per lb.

TOBACCOS.

Countries of Origin:—Uganda, East Africa Protectorate, Rhodesia, Union of South Africa, Northern Nigeria, Seychelles, Mauritius, Ceylon, India, British Honduras, Bermuda, United Kingdom and Foreign Countries.

In connection with the tobacco cultivation experiments started by the Government of Uganda a sample of cotton seed ash was examined as a manure for tobacco. It proved to contain 7·51 per cent. of potash, and was therefore a suitable though rather poor manure for this purpose. Enquiries relating to remedial measures against fungoid and insect pests on tobacco in Rhodesia and Uganda were dealt with. A sample of pipe tobacco from the Transvaal proved to be of fair "bright" quality, and was valued by experts at 5*d.* per lb. A sample of Turkish tobacco from Cape Province was regarded by experts as of very promising quality, and was valued at 1*s.* to 2*s.* per lb. when properly graded. An offer was made by one firm to purchase a small consignment of this Cape Turkish tobacco for trial.

A series of samples of soil, plant ashes, and Turkish tobacco from Bermuda was examined in connection with the tobacco cultivation experiments in that island, and a small reference collection of commercial Turkish tobaccos was supplied to Bermuda as a guide to the preparation of Turkish tobacco for the market.

The other tobacco samples examined and reported on represented products obtained in preliminary experiments or prepared by natives, and though sometimes of promising character were usually of little commercial value. A number of enquiries re-

lating to the cultivation of tobacco, the preparation of nicotine from waste tobacco, and other similar matters were dealt with.

At the close of the year tobaccos from Cape Province, Mauritius, Ceylon, and India were under examination.

Gums.

Countries of Origin:—Uganda, East Africa Protectorate, Union of South Africa, Northern Nigeria, United Kingdom and Foreign Countries.

Of the gums received for examination only those from Northern Nigeria need be specially commented on. They included a series of samples from the principal gum-yielding trees of Sokoto, Yola, and Bornu Provinces, and in some cases were accompanied by herbarium specimens which enabled their botanical sources to be ascertained. In this way it has been established that the species which yield gum in Northern Nigeria are the same as those which furnish the gums of the Sudan and Senegal which form the bulk of those met with in commerce. Further, it appears likely that in Northern Nigeria single gum-yielding species frequently occur over considerable areas, so that it ought to be possible to arrange for the collection of gum from a single species, and thus avoid the export of mixed gums. From Bornu Province a number of small consignments of graded gum obtained from *Acacia Senegal* and *Acacia arabica* were received. These were analysed, and in some cases practical trials were also made with the gums by manufacturing confectioners. A full account of the results of this work on Nigerian gums has been published in the *Bulletin of the Imperial Institute*, Vol. VIII. (1910), p. 352.

Drugs and Poisonous Plants.

Countries of Origin:—Sudan, East Africa Protectorate, Union of South Africa, Northern Nigeria, Southern Nigeria, Gold Coast, Sierra Leone, Ceylon, India, Straits Settlements, Hong Kong, Australian Commonwealth, Canada, United Kingdom and certain Foreign Countries.

Union of South Africa.—Preliminary reports were made on *Homeria pallida* and *Dichapetalum cymosum*, plants which are reputed to be poisonous to cattle in the Transvaal, and further supplies of the materials were requested in order that the investigations could be completed. At the end of the year *Acokanthera venenata* and *Mesembryanthemum Mahoni*, also from the Transvaal, were under investigation. From the Cape Province "Slangkop" and *Senecio latifolius*, both of which are also poisonous to cattle, were received for examination. The work on the chemistry of *Senecio latifolius* has been completed and the physiological action of the constituents isolated is being studied by Dr. Cushny, F.R.S., of University College, London.

British West Africa.—From Northern Nigeria three native drugs were received for examination, but none of these proved to contain constituents likely to make them of value in European medicine. Herbarium specimens of the so-called "bitter kola" of Southern Nigeria, of which the seeds were examined at the Imperial Institute in 1909 and shown to contain no caffeine, were received and identified at Kew as *Garcinia Conrauana*. Kola nuts

derived from *Cola acuminata*, *C. verticillata*, and *C. Johnsonii* from the Gold Coast were examined and found to contain 0·73, 0·55, and 0·67 per cent. of total alkaloids, calculated on the *fresh* nuts containing respectively 50·1, 52·1, and 49·3 per cent. of moisture. This difference in alkaloidal content no doubt accounts for the preference shown by the natives for the nuts of *C. acuminata*, which also possess a more marked flavour than either of the other two kinds. Further samples of all three kinds were under examination at the end of the year. Considerable progress was made with the examination of a series of native drugs received from Sierra Leone.

Ceylon.—Samples of Coca leaves, leaves of *Ipomoea sumata* and of *Adhatoda Vasica* were received from Ceylon, and the examination of the two first-named drugs is in progress.

India.—The work on Indian aconites referred to in the report for 1909 was continued, and that on Solanaceous drugs was carried further by the examination of a specimen of *Datura Metel* from the Punjab. The leaves and stems contained 0·2 per cent. of alkaloid consisting of scopolamine with a little atropine. Memoranda were supplied to the Indian Government on (1) Indian drugs likely to find a market in the United Kingdom, (2) improvements in the manufacture of opium alkaloids. At the close of the year a large number of Indian drugs were still under examination. They included *Podophyllum Emodi* roots, *Datura Metel* capsules and seeds, *Hyoscyamus niger* seeds, *Thalictrum foliolosum* roots, *Peganum Harmala* seeds, various species of Indian aconites and an extensive series of samples of opium collected in all the principal opium-producing districts of India.

Straits Settlements.—A number of samples of morphine and cocaine were received from this Colony for analysis and valuation.

Australian Commonwealth.—The bark of *Xanthoxylum brachyacanthum* was received from Queensland for examination and samples of *Homeria* spp. from South Australia. The latter are plants poisonous to cattle, which are being examined in connection with the similar work referred to under the Union of South Africa (p. 36).

Canada.—A supply of *Senecio Jacobæa*, which is reputed to produce the "Picton cattle disease" in certain parts of Canada, was received for examination in extension of the work on poisonous plants referred to under the Union of South Africa. (p. 36).

Tanning Materials.

Countries of Origin:—Cyprus, Sudan, East Africa Protectorate, Union of South Africa, Seychelles, Straits Settlements and Federated Malay States, and United Kingdom.

Sudan.—The materials examined included barks from the "talh" and "subakh" trees and so-called "tannin grains" prepared from sant pods. The first two were not promising materials for export, but the "tannin grains" were very rich in tannin, and yielded an almost white leather, and would be very saleable at good prices in the United Kingdom.

East Africa Protectorate.—Six samples of wattle bark from this Protectorate were reported on. They were all of good quality, containing from 35·8 to 43·6 per cent. of tannin, calculated on the air-dry barks, and were valued at prices varying from £8 to £8 15*s.* per ton which compares favourably with the prices quoted for Natal and Australian wattle barks.

Union of South Africa.—From the Transvaal Province 10 samples of wattle bark and four of so-called Transvaal sumach (*Osyris abyssinica*) were received and examined. The wattle barks were of good quality, containing from 36·7 to 42·0 per cent. of tannin except in one or two cases where the bark had obviously been damaged by forest fires or in other ways. The samples were valued at prices ranging from £7 5*s.* to £9 per ton. The "Transvaal sumach" contained from 13·6 per cent. of tannin in the "leaves and twigs" to 24·7 per cent. in the dry leaves. This material would not be very suitable for export, but is a good tanning agent for local use.

Straits Settlements.—Samples of leaves and twigs of *Uncaria Gambier* were received for trials in connection with suggested improvements in the method of manufacturing gambier. The leaves contained 10·4 per cent. of tannin and the twigs 6·2 per cent. Extracts made from the two materials yielded 65·0 and 53·0 per cent. of tannin respectively.

India.—At the end of the year twelve tanning extracts made at the Government factory, Rangoon, were under examination and trial.

United Kingdom.—A number of enquiries were received from persons and firms in the United Kingdom with reference to wattle cultivation in the East Africa Protectorate, Natal, Transvaal and elsewhere. Other enquiries related to algarobilla, mangrove cutch, new sources of eucalyptus, kino, &c.

Resins.

Countries of Origin:—Uganda, Natal, Northern Nigeria, Southern Nigeria, Gold Coast, Ceylon, India, Straits Settlements, Federated Malay States, Queensland, St. Vincent, United Kingdom and Foreign Countries.

Samples of the resinous exudation of *Haronga madagascariensis* were received from Uganda for examination as a gamboge-substitute, but the material, though similar in colour to gamboge, proved to be quite different in properties.

Three grades of copal forwarded for examination and valuation from Southern Nigeria proved to be "recent" copals of a fair quality and were valued, the best at 45*s.* to 47*s.*, and the other two at 35*s.* per cwt.

Concreted oleo-resin of *Daniella thurifera* from the Gold Coast was examined as a "copal" but it proved to be of inferior quality as a varnish resin. Fresh oleo-resin of this tree received from the Gold Coast and Northern Nigeria was under examination at the end of the year.

A number of samples of lac resin from India were examined. They included lac grown on *Pithecolobium Saman* in Baroda

State. The seed lac from this source was of satisfactory composition and was valued at 55*s*. to 60*s*. per cwt.

At the end of the year samples of "black dammar" and of colophony prepared in special ways in India were under examination. A portion of a stem carrying a crystalline resinous substance was received from the Straits Settlements for examination and a sample of the sap of the Kruing tree was forwarded from the Federated Malay States. Both were under examination at the close of the year.

In connection with enquiries on resins information was supplied as to the origin of gommier resin, the sale of Australian white pine resin in the United Kingdom, new sources of supply of rosin, the source of supply of "chicle," and the utilisation of Euphorbia resins.

Timbers.

Countries of Origin:—Uganda, East Africa Protectorate, Gold Coast, Sierra Leone, Mauritius, Tasmania, British Guiana, and United Kingdom.

Samples of *Pterocarpus erinaceus* wood were received from Sierra Leone for trial in the construction of musical instruments, but the timber proved to be of no special value for this purpose. A series of ten timbers from Uganda was under examination at the end of the year. From British Guiana a number of samples of cedar wood were received for trial as materials for making cigar boxes, and these were under examination at the close of the year. The same Colony also submitted samples of so-called "cork woods" for technical trial.

From the United Kingdom a number of enquiries were received relating to the timber resources of various parts of the Empire, sources of supply of timbers, and to the identification of samples.

Natural Dyestuffs.

Countries of Origin:—Northern Nigeria, Southern Nigeria, Sierra Leone, Mauritius, Sarawak, United Kingdom.

Most of the samples of natural dyestuffs received for investigation were forwarded in connection with an enquiry into the sources of the natural red dyes of West Africa, and especially of those used in dyeing native leather. A sample of the wood of *Sarcocephalus esculentus*, said to be used as a yellow dye by natives in Southern Nigeria proved on examination to be devoid of tinctorial properties. Logwood from Mauritius was favourably reported on by commercial experts in the United Kingdom and an offer to purchase consignments of this dyewood from Mauritius was made to the Imperial Institute and transmitted to the Government of Mauritius. A specimen of Sappan-wood was received from Sarawak for valuation. The enquiries received from the United Kingdom included requests for the identification of various natural dyestuffs.

Miscellaneous Products.

Countries of Origin:—Union of South Africa, Northern Nigeria, Southern Nigeria, Gold Coast, Ceylon, India, Bermuda, Canada, Newfoundland, United Kingdom, and Foreign Countries.

In this group are included a number of products which do not readily fall into any of the classes of products dealt with in the preceding sections. They include a series of herbarium specimens from Northern Nigeria, which are still under investigation at the Royal Gardens, Kew, a specimen of tar obtained from Casuarina wood in India, which was valued at £3 to £4 per ton, loofahs from Bermuda, and seaweed from Newfoundland. The last-mentioned product was investigated as a source of sizing material. In addition a number of miscellaneous samples for identification were received from persons and firms in the United Kingdom. Specimens of calabashes from Mozambique were reported on for pipe-making and a sample of mangrove pitch from the same country was examined and found to be of promising quality.

Animal Products.

Countries of Origin:—Union of South Africa, Sudan, Seychelles, India, South Australia, British West Indies, United Kingdom, Foreign Countries.

The materials examined included sponges from the Seychelles, St. Vincent, and South Australia, mother-of-pearl shells from the Bahamas and tortoise-shell from Mozambique. Several memoranda were supplied to the Government of India on the markets existing in Europe for hides and skins of various kinds, feathers and hair. At the end of the year a consignment of ostrich feathers from the Sudan was under examination.

General Enquiries.

The foregoing sections describing the work of the Scientific and Technical Department relate mainly to materials submitted for investigation through official channels, or samples forwarded by merchants for identification. In addition to this class of work an increasing number of enquiries of a commercial character, involving scientific and technical questions, is now being received each year. These enquiries are chiefly of two classes: (1) requests for advice from officials of technical departments in the Colonies and India as to the cultivation of new products, the commercial value of little known materials, or methods of marketing produce, and (2) requests from merchants and manufacturers chiefly in the United Kingdom for information as to new sources of raw materials, advice regarding the production of new materials in the Colonies, &c.

The number of such inquiries dealt with in 1910 was 298, exclusive of those relating to settlement, emigration and other matters. Illustrations of the wide range of these enquiries were given in the report for 1909. In 1910 a large proportion of the enquiries related to oil-seeds and oils. This was due to the fact that these products were scarce and dear during the year, and consequently users of such materials were anxious to know of new sources of supply and of new products of this character. Many enquiries were also received on the subjects of cotton and coarse textile fibres and with reference to the cultivation, preparation and quality of various kinds of rubber. Other subjects which received

a good deal of attention in this way were minerals, drugs, volatile oils, tanning materials and timbers.

VIII.—SUBSIDIARY WORK.

During the year meetings, receptions, and lectures were held at the Imperial Institute under the auspices of the British Women's Emigration Association, the Colonial Nursing Association, the African Society, the Anglo-Russian Literary Society, the London Needlework Guild, the Women's Indian Study Association, the Australian League, the British Empire Shakespeare Society, and the Women's Aerial League of the British Empire. In February a lecture on Canada, by Miss Deans Cameron, organised by the British Women's Emigration Association, was given, when Their Royal Highnesses the Duke and Duchess of Connaught, the Princess Patricia of Connaught, and the Princess Louise, Duchess of Argyll, were present. The British Medical Association were afforded accommodation in the rooms of the Imperial Institute for their annual meeting in London in July.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
652	Bechuanaland Protectorate	1909–1910
653	Ceylon	1909
654	Gold Coast	"
655	Nyasaland	1909–1910
656	Imperial Institute	1909
657	Fiji	"
658	Grenada	"
659	Hong Kong	"
660	Barbados	1909–1910
661	Swaziland	"
662	Jamaica	"
663	Straits Settlements	1909
664	Trinidad and Tobago	1909–1910
665	Southern Nigeria	1909
666	Mauritius	"
667	British Honduras	"
668	St. Vincent	1909–1910
669	East Africa Protectorate	"
670	Uganda	"
671	British Guiana	"
672	St. Lucia	1909
673	Leeward Islands	1909–1910
674	Northern Nigeria	1909
675	St. Helena	1910
676	Gibraltar	"
677	Basutoland	1909–1910
678	Weihaiwei	1910
679	Gambia	"
680	Ashanti	"
681	Turks and Caicos Islands	"
682	Falkland Islands	"
683	Northern Territories of the Gold Coast	"
684	Bahamas	1910–1911
685	Colonial Survey Committee	"
686	Malta	1910–1911

MISCELLANEOUS.

No.	Colony, &c.	Subject.
69	St. Helena	Fisheries.
70	Colonies	List of Laws relating to Patents, Trade Marks, &c.
71	Imperial Institute	Foodstuffs.
72	Fiji	Hurricane, 1910.
73	Jamaica	Cayman Islands.
74	Ceylon	Mineral Survey 1906–7 and 1907–8.
75	West Indies	Imperial Department of Agriculture.
76	Southern Nigeria	Mineral Survey, 1907–8.
77	St. Vincent	Roads and Land Settlement Fund.

COLONIAL REPORTS—ANNUAL.

No. 737.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, 1911.

(For Report for 1910, *see* No. 687 [Cd. 5467-23] of 1911.)

Presented to both Houses of Parliament by Command of His Majesty.
October, 1912.

LONDON:
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.
To be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LIMITED, FETTER LANE, E.C., and
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PRINTED BY
DARLING AND SON, LTD., BACON STREET, E.
1912.

[Cd. 6007-37.] *Price* 2½*d.*

No. 737.

IMPERIAL INSTITUTE, 1911.

(For Report for 1910, *see* No. 687 [Cd. 5467-23.] of 1911.)

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE IN 1911. BY PROFESSOR WYNDHAM R. DUNSTAN, M.A., LL.D., F.R.S., *Director*.

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I.—PREFATORY STATEMENT.

THE IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA.

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The First Commissioner of His Majesty's Treasury.
The Secretary of State for the Colonies.
The Secretary of State for India.
The President of the Board of Trade.

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Director.

Professor Wyndham R. Dunstan, M.A., LL.D., F.R.S.

The Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May, 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of the Colonies and India, and providing for their

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investigation and for the collection and dissemination of scientific, technical, and commercial information relating to them.

The work of the Imperial Institute is at present carried on under four principal divisions: (1) the Colonial and Indian Collections, consisting mainly of raw materials and primary manufactures displayed in the public exhibition galleries, and including a Central Stand for receiving enquiries and distributing publications; (2) the Scientific and Technical Department, including a special staff and research laboratories, occupying the second floor of the building; (3) the Reference Library, containing a large collection of works of reference relating to the Colonies and India, together with the principal periodicals and newspapers; (4) the "Bulletin of the Imperial Institute," a quarterly publication containing a record of the work of the Imperial Institute in its various branches, as well as special articles on progress in tropical agriculture and industries and the commercial utilisation of the natural resources of the Colonies and India.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which His Royal Highness the Prince of Wales (afterwards King Edward VII.) was President, and an Executive Council, including representatives of the Indian Empire, and of all the British Colonies and Dependencies. In 1900 the building became the property of His Majesty's Government, by whom the western portion of the main building and the galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portion of the main building being assigned, subject to rights of usage, for occupation by the University of London. In July, 1902, an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee, including representatives of the Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A committee of management of three members, one nominated by each of the three Government departments chiefly concerned, has been appointed, and at present consists of Mr. C. A. Harris, C.B., C.M.G., M.V.O., Sir Alfred Bateman, K.C.M.G., and Colonel Duncan Pitcher (late Indian Army).

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their

relation to agriculture and the commercial utilisation of economic products.

The following are the principal departments of the Institute:—

Exhibition Galleries.—The collections of economic products, &c., illustrative of the general and commercial resources of the Colonies and India are arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday, and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter.

The following British Dominions, Colonies and Dependencies are represented by collections, which are in charge of technical superintendents:—

Canada, Newfoundland, Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahamas, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda, Falkland Islands, New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, Papua, New Zealand, Fiji, Western Pacific Islands, Union of South Africa, Rhodesia, Nyasaland, St. Helena, Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, East Africa Protectorate, Zanzibar and Pemba, Uganda, Somaliland, Anglo-Egyptian Sudan, Malta, Cyprus, Ceylon, Hong Kong, Mauritius, Seychelles, Straits Settlements, Federated Malay States, and India.

Special arrangements are made to conduct parties from schools and institutions through the Colonial and Indian collections for educational purposes.

A stand has been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Pamphlets, circulars, handbooks, &c., containing information relating to the commerce, agriculture, mining, and other industries of the principal Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. Lists of the publications available for distribution or sale are provided, and the principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the departments in the main building.

The Scientific and Technical Department.—The research laboratories of this department, which occupy the second floor of the Imperial Institute, were established in order to provide for the investigation of new or little-known natural products from the Colonies and India and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade and industries of the Colonies and India.

The work of this department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have been also made by the Foreign Office, whereby

British representatives abroad may transmit to the department for investigation such natural products of the countries in which they are appointed to reside as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the department and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

A reference sample room is maintained in this department, in which are arranged samples of the principal materials which have been investigated and valued commercially during recent years, and as to which full information is available.

The Scientific and Technical Department works in co-operation with the Agricultural and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations and enquiries as are of a special scientific and technical character connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial value of products (animal, vegetable or mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which has been printed in a volume of Technical Reports and Scientific Papers, published in 1903. A series of selected reports is now being issued in the Miscellaneous Series of Colonial Reports. Of these selected reports, four parts have been published: Part I., "Fibres" [Cd. 4588]; Part II., "Gums and Resins [Cd. 4971]; Part III., "Foodstuffs" [Cd. 5137]; Part IV., "Rubber and Gutta-Percha" [Cd. 6022]; whilst others are in active preparation.

Mineral Surveys, under the supervision of the Director of the Imperial Institute, and conducted by surveyors selected by him, are in progress in Ceylon and Southern Nigeria. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained.

Reports by the Director on the results of mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

African Tropical Service Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction on the subject of tropical cultivation and products in this course is given by members of the staff of the Imperial Institute.

Library and Reading Rooms.—The library and reading rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference and are regularly supplied with the more important official publications, and with many of the principal newspapers and periodicals of the United Kingdom, the Dominions, Colonies and India.

The library and reading rooms are on the first floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute and of other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownaggree corridor and rooms in connection with this hall are in the occupation of the Indian section of the Imperial Institute. The hall is available for lectures, meetings, &c.

The "Bulletin of the Imperial Institute" is published quarterly by Mr. John Murray, 50a, Albemarle Street, London, price 2*s.* 6*d.* (annual subscription 11*s.*, including postage) and may be purchased through any bookseller, or from agents in the Colonies and India. The Bulletin contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (animal, vegetable and mineral).

The following societies have their headquarters at the Imperial Institute:—

International Association of Tropical Agriculture and Colonial Development, British Section.—The object of this Association, the central bureau of which is in Paris, is the promotion of the scientific and practical study of all questions connected with tropical agriculture and the development and utilisation of natural resources, especially of tropical countries. The British section has its headquarters at the Imperial Institute. Members of the British section are permitted to use the library and reading rooms of the Imperial Institute, and a writing room has been also provided for their use.

British Women's Emigration Association.—The British Women's Emigration Association has been assigned offices on the mezzanine floor, which are open daily from 10 a.m. to 4 p.m., and advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge.

Colonial Nursing Association.—An office has been allotted on the mezzanine floor of the Imperial Institute to this Association, the principal object of which is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependencies.

The *African Society* and *Imperial Co-operative League* were also housed at the Institute for a portion of the year under review.

II.—GENERAL.

The present report relates to the work which has been carried out in the several departments of the Imperial Institute during the year 1911, and is in continuation of previous reports (Report for 1906 and 1907, Cd. 3729-48; Report for 1908, Cd. 4448-10; Report for 1909, Cd. 4964-30; Report for 1910, Cd. 5467-23).

In each of its departments the work of the Imperial Institute shows continued progress.

Reference has been made in previous Annual Reports to the need for further accommodation within the Imperial Institute building for the rapidly growing work of the Imperial Institute. In order to obtain some slight relief from the congestion which at present exists, a rearrangement of the general offices, of the library, and of the offices of certain societies which have their headquarters at the Imperial Institute has been effected. The general offices have been moved from the first floor to the principal floor, thus providing a small increase of space and other facilities. The library has been transferred from the principal floor to the first floor. These changes necessitated the removal of the offices of the British Women's Emigration Association and the Colonial Nursing Association from the first floor to the less convenient mezzanine floor. These societies, while consenting to the change, have emphasized their need for better accommodation than can be provided at the present time. Want of space also renders it impossible at present to offer accommodation to several other societies carrying on Imperial work of the character included in the objects for the promotion of which the Imperial Institute was founded.

The congestion arising from want of storage accommodation and the need for an extension of the Scientific and Technical Department, and the inconvenience resulting from the absence of a central connection for the Public Exhibition Galleries still remain.

The more important features of the work in each department of the Institute during 1911 are recorded in the following sections.

III.—STAFF.

During the year 1911 the principal members of the staff were as follows:—

Director of the Imperial Institute:—
Wyndham R. Dunstan, M.A., LL.D., F.R.S.

Director's Office.

Secretary to the Director:—
Major E. J. Lugard, D.S.O.
Assistant Secretary to the Director:—
J. J. K. Greenway, B.A. (Cantab.).

SCIENTIFIC AND TECHNICAL DEPARTMENT.

Superintendent of Laboratories:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
Technical Superintendent:—
Harold Brown.
Principal Assistant:—
E. Goulding, D.Sc. (Lond.), F.C.S.
Special Assistants:—
H. H. Robinson, M.A. (Oxon.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
B. E. Long, B.A. (Cantab.).
H. J. Jeffery, A.R.C.S., F.L.S.
Senior Assistants:—
T. Crook, A.R.C.S.I., F.G.S.
A. E. Andrews, F.C.S.
S. J. Johnstone.
R. G. Pelly, F.I.C.
S. J. M. Auld, Ph.D. (Würzburg), D.Sc. (Lond.), (until January, 1911).
S. S. Pickles, D.Sc. (Vict.), F.C.S.
R. Gaunt, Ph.D. (Berlin), F.C.S.
Assistants:—
W. O. R. Wynn.
N. C. Akers, A.I.C. (until November, 1911).
G. M. Davies.
O. D. Roberts, A.I.C.
J. Shelton, A.I.C.
L. Wilson, B.Sc. (Lond.).
B. W. Whitfeild.
G. T. Bray.
J. R. Furlong, Ph.D. (Würzburg).
H. W. Winter.
J. C. Earl.

The special officers of the Mineral Surveys of Ceylon and Southern Nigeria, which have been in progress under the supervision of the Director of the Imperial Institute, were:—

Ceylon:—
J. S. Coates, B.A. (Cantab.).
F. D. Paisley, B.A. (Cantab.), (until August, 1911).
Southern Nigeria:—
A. E. Kitson, F.G.S., F.R.G.S., M.Aust.I.M.E.
A. D. Lumb, A.R.S.M., F.G.S.

EXHIBITION GALLERIES:—COLONIAL AND INDIAN COLLECTIONS.

Technical Superintendents:—
W. G. Freeman, B.Sc. (Lond.), F.L.S. (until April, 1911).
S. E. Chandler, D.Sc. (Lond.), F.L.S.
H. Spooner.
A. B. Jackson.
Assistant Technical Superintendent:—
F. W. Rolfe.

African Tropical Service Course.

Instructors in Tropical Cultivation:—
W. G. Freeman, B.Sc. (Lond.), F.L.S. (until April, 1911).
S. E. Chandler, D.Sc. (Lond.), F.L.S.
Instructors in Tropical Products:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
Harold Brown.
E. Goulding, D.Sc. (Lond.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
R. G. Pelly, F.I.C.

The following members of the Staff have left to fill the appointments indicated:—

Mr. W. G. Freeman, B.Sc. (Lond.), F.L.S., was appointed Assistant-Director of Agriculture and Government Botanist in Trinidad.

Dr. S. J. M. Auld was appointed Lecturer in Agricultural Chemistry and Chief of the Chemistry Department at the South-Eastern Agricultural College, Wye, Kent.

Mr. N. C. Akers, A.I.C., was appointed Chief Assistant and Lecturer in Chemistry at the Borough Polytechnic Institute.

IV.—PUBLIC EXHIBITION GALLERIES.

The principal aim of the Colonial and Indian Collections in the Public Exhibition Galleries is to illustrate by means of exhibits, chiefly consisting of raw products and primary manufactures, the commercial and industrial resources of the various parts of the British Empire, and by these and other exhibits to present a view of their general position and resources.

The Ceylon Court has been extended and improved. A large number of important exhibits have been supplied by the Ceylon Government, new show-cases provided and the whole Court rearranged, so that it is now a most satisfactory representation of the present position and resources of the Colony.

At the instance of the Ceylon Government and of the Planters' Association a pavilion or rest-house is being erected as an extension of the Ceylon Court.

The arrangement of a new court for Newfoundland is in progress, and exhibits for this purpose have been provided by the Newfoundland Government.

The reorganisation of the present collections of the Cape of Good Hope, Natal, Transvaal, and Orange Free State, to form one section for the Union of South Africa, is in progress.

A court illustrating the resources of Papua has been installed in the central gallery, with funds specially provided by the Commonwealth Government of Australia.

A scheme for the re-equipment of the British Guiana Court is under consideration by the British Guiana Government.

Additional exhibits comprising economic products, photographs, maps, &c., have been received for the courts of the following Dominions, Colonies and Dependencies:—

Canada, Jamaica, British Guiana, Trinidad and Tobago, Antigua, Dominica, Montserrat, St. Kitts, Nevis, St. Lucia, Virgin Islands, Falkland Islands, New South Wales, Victoria, Queensland, South Australia, New Zealand, Fiji, Western Pacific Islands, Union of South Africa, Nyasaland, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, East Africa Protectorate, Uganda, Sudan, Ceylon, Mauritius, Straits Settlements, Federated Malay States, and India.

Several additions have been made to the Royal presents and addresses which are graciously lent by Their Majesties the King and Queen for exhibition in the Public Galleries.

The Reference Collection in the Upper East Gallery of the principal standard commercial products of the world has proved of great value to visitors, and has facilitated the comparison of new products received from the Colonies with those of established commercial and industrial value.

A descriptive catalogue of the Sudan Court was prepared and printed in the "Bulletin of the Imperial Institute," Vol. IX. (1911), No. 2, and separate copies are available at the Central Stand in the Galleries.

A collection of exhibits from the Indian Section and from several of the Courts of the Crown Colonies was lent to the Festival of Empire at the Crystal Palace.

A collection of specimens of Indian timbers was presented by request to the University of Cambridge for the use of forestry students.

Specimens of Colonial timbers and of fibres from the Colonies and India were presented to the Imperial College of Science and Technology for reference and teaching purposes.

Specimens of Colonial and Indian products were presented to the Stockport Museum and to several schools to assist in the teaching of commercial geography and the formation of school museums.

Collections of products from the East Africa Protectorate were lent to the Coronation Exhibition at Shepherd's Bush and to the International Rubber Exhibition. A special exhibit was also forwarded to the latter Exhibition from the Imperial Institute to illustrate rubber production throughout the Empire.

A number of visits to the Public Galleries have been made by parties from schools, which have in many cases been personally conducted through the Galleries by the Technical Superintendents.

The number of visitors to the Exhibition Galleries during 1911 was 210,663, including 25,062 visitors to the Exhibition of the Royal Coronation Robes (*see* p. 45), as compared with 167,440 in 1910. The number of publications relating to the Colonies and India distributed to enquirers at the Central Stand was 16,464, as compared with 14,056 in 1910.

V.—THE LIBRARY.

Lists of the chief works which were added to the library in the course of the year have been published in the "Bulletin of the Imperial Institute."

In addition to its use by the staff and by life fellows, the library is largely consulted by enquirers for special information and other visitors who are duly introduced.

VI.—"BULLETIN OF THE IMPERIAL INSTITUTE," AND OTHER PUBLICATIONS.

Bulletin of the Imperial Institute.

The Bulletin of the Imperial Institute is a quarterly record of progress in tropical agriculture and industries and the commercial utilisation of the natural resources of the Colonies and India.

The Bulletin is edited by the Director of the Imperial Institute and prepared by the Scientific and Technical Staff of the Imperial Institute and by other contributors. In the year 1911 it was enlarged and it is published by Mr. John Murray, Albemarle Street, London, W. (price 2*s.* 6*d.* net, annual subscription 11*s.* including postage).

The following are the titles of the articles which have appeared in the quarterly numbers of the Bulletin of the Imperial Institute, Vol. IX, 1911:—

Reports on Investigations:—

Ceara Rubber.
Turpentine Oil from India.
Rosin from India.
Flax from the East Africa Protectorate.
Cotton from the Cape Province, South Africa.
Grape Fruit from the East Africa Protectorate.
"Amang" from the Federated Malay States.
Monazite Sand from Travancore, India.
Use of Dum Palm Nuts as Vegetable Ivory.
Solanaceous Drugs from India.
Cotton Growing in Sind.
Bassia Kernels and Fats.
Beeswax from Northern Nigeria.
The Aromatic Grass Oils.
The "Ibean Camphor" Tree of the East Africa Protectorate.
Para Rubber from Seychelles.
The Causation of Molteno, Pictou or Winton Disease in Cattle and Horses.
The Irritant Action of Satinwood.
Strüverite, a rare Tantalum Mineral from the Federated Malay States.

General Notices respecting Economic Products and their Development:—

The Cultivation, Production, Preparation and Utilisation of Castor Seed.

Utilisation of Para Rubber Seed.
Guano Deposits of Assumption Island, Seychelles.
Preparation of Calcium Cyanamide and its Uses as a Manurial Agent.
The Utilisation of Wattle Bark.
Kapok and its Cultivation.
The Distribution and Uses of Titanium Ores.
Utilisation of Sudan Dura Grain in Europe.
Cultivation, Production and Utilisation of Sesamum Seed.
Fodder Plants Indigenous to Australia.
Export Trade of Seychelles.
Cultivation, Preparation and Production of Flax and Linseed.
Agricultural Development of Nyasaland.

General Notes:—

Chromite from Baluchistan.
Valuation of Natural Phosphates for Industrial Purposes.
Cotton from the New Hebrides.
Cascarilla Bark from the Bahamas.
The Leather Industries of the Bombay Presidency.
"La Culture du Coton dans le Monde."
Agriculture and Industry in Grenada.
The Natural Resources of British Guiana.
East African Cedar.
Timbers from Mysore.
Chicle or Sapodilla "Gum."
"Papers and Reports on Cotton Cultivation."
Estimation of the Alkaloid Codeine in Opium.
Lophira alata Seed Oil.
Para Rubber Seed Oil.
Camphor Cultivation in German East Africa.
Heveas in West Africa.
Sakellaridis Cotton.
Timber Industry of German East Africa.
Essential Oil of *Myrica Gale*.
Trieste Origanum and White Thyme.
Chlorocodon Roots from Uganda.
Agriculture in Quilimane.
Recent Progress in Agriculture and the Development of Natural Resources—General Agriculture, Foodstuffs, Fodders, Oilseeds and Oils, Rubber, Fibres (including Cotton), Essential Oils, General Forestry, Forest Products, Economic Minerals, &c.
Notices of Recent Literature—New Books.
Colonial and Indian Collections—The Court of the Anglo-Egyptian Sudan.
Library—Recent Additions.

Other Publications.

During the year the following publications relating to the work of the Imperial Institute have been issued:—

Reports on the Results of the Mineral Survey of Southern Nigeria, 1907-08 (Colonial Reports, Miscellaneous,

No. 76, Cd. 5517), and 1908-09 (Colonial Reports, Miscellaneous, No. 81, Cd. 5901).

Report on the Results of the Mineral Survey of Northern Nigeria, 1907-08 and 1908-09 (Colonial Reports, Miscellaneous, No. 79, Cd. 5899).

Report on the Results of the Mineral Survey of Nyasaland, 1908-09 (Colonial Reports, Miscellaneous, No. 80, Cd. 5900).

Annual Report on the Work of the Imperial Institute, 1910 (Colonial Reports—Annual, No. 687, Cd. 5467-23).

Imperial Institute Handbooks on Tropical Resources.—The Secretary of State for the Colonies has authorised the preparation of this series of Handbooks, which will deal with the commercial resources of the Tropics, with special reference to West Africa. The series is edited by the Director of the Imperial Institute and published by Mr. John Murray. The first volume appeared in August, 1911, and is entitled "The Agricultural and Forest Products of British West Africa," by G. C. Dudgeon, Director-General of Agriculture in Egypt, lately Inspector of Agriculture for British West Africa. Other volumes were in preparation at the end of the year.

The International Association of Tropical Agriculture and Colonial Development has issued the Report on the Present Position of the Cotton Cultivation of the World, which was made by Professor Dunstan to the International Congress of Tropical Agriculture, held in Brussels in May, 1910, and also a volume of Papers and Reports on Cotton Cultivation, presented to the same Congress, collected and edited by Professor Dunstan.

The following is a list of the principal papers contributed to scientific and technical journals by members of the scientific staff of the Imperial Institute during the year:—

"The Aerial Oxidation (Rusting) of Metals." By Prof. W. R. Dunstan and J. R. Hill. (Transactions of the Chemical Society, 1911, Vol. 98, p. 1835.)

"The Passivity of Iron and certain other Metals." By Prof. W. R. Dunstan and J. R. Hill. (Transactions of the Chemical Society, 1911, Vol. 98, p. 1853.)

"Les Ressources caoutchoutières de l'Afrique occidentale anglaise." By H. Brown. (L'Agronomie Tropicale, 1911, Vol. 3, pp. 46, 56, 65, 91, 97.)

"Note on *p*-methoxysalicylaldehyde and its occurrence in the root of a species of Chlorocodon." By Dr. E. Goulding and R. G. Pelly. (Proceedings of the Chemical Society, 1911, Vol. 27, p. 235.)

"The Constituents of the Oil of *Pinus longifolia*." By H. H. Robinson. (Proceedings of the Chemical Society, 1911, Vol. 27, p. 247.)

"The Rocks and Minerals of Natal and Zululand." By Dr. J. W. Evans. (Proceedings of the Geologists' Association, 1911, Vol. 22, p. 156.)

"Dreikanter." By Dr. J. W. Evans. (Geological Magazine, 1911, Vol. 8, p. 334.)

"On Dedolomitization." By T. Crook. (Geological Magazine, 1911, Vol. 8, p. 339.)

"Some Observations on Pleochroism and Idiophany in Mineral Plates." By T. Crook. (Mineralogical Magazine, 1911, Vol. 16, p. 1.)

"Further Remarks on the Electrostatic Separation of Minerals." By T. Crook. (Mineralogical Magazine, 1911, Vol. 16, p. 109.)

"The Active Constituents of the Indian Solanaceous Plants: *Datura Stramonium*, *D. fastuosa* and *D. Metel*." By A. E. Andrews. (Transactions of the Chemical Society, 1911, Vol. 98, p. 1871.)

"The Determination of Codeine in Opium." By A. E. Andrews. (Analyst, 1911, Vol. 36, p. 489.)

"Vers à Soie Sauvages Africains." By F. W. Barwick. (L'Agronomie Tropicale, 1911, Vol. 3, pp. 44, 49.)

"Composition of the Essential Oil of *Myrica Gale*, L." By Dr. S. S. Pickles. (Transactions of the Chemical Society, 1911, Vol. 98, p. 1764.)

"The Carbohydrate Constituents of Para Rubber: Separation of *l*-methylinositol." By Dr. S. S. Pickles and B. W. Whitfeild. (Proceedings of the Chemical Society, 1911, Vol. 27, p. 54.)

"The Essential Oil of *Origanum hirtum*, Link." By Dr. S. S. Pickles. (Proceedings of the Chemical Society, 1911, Vol. 27, p. 284.)

"The Essential Oil of Dalmatian White Thyme." By Dr. S. S. Pickles. (Proceedings of the Chemical Society, 1911, Vol. 27, p. 285.)

"Composition of Para Rubber-seed Oil." By Dr. S. S. Pickles and W. P. Hayworth. (Analyst, 1911, Vol. 36, p. 491.)

"Composition of the Fat from the Seeds of *Lophira alata*, Banks." By Dr. S. S. Pickles and W. P. Hayworth. (Analyst, 1911, Vol. 36, p. 493.)

"Les Essences Aromatiques de Graminées." By Dr. S. S. Pickles. (L'Agronomie Tropicale, 1911, Vol. 3, pp. 113, 150, 157.)

VII.—SCIENTIFIC AND TECHNICAL DEPARTMENT.

An account is given in the succeeding pages of the work carried on in this Department during the year, partly in conducting scientific, technical, and commercial investigations as to the composition and value of raw materials, animal, vegetable and mineral, and partly in supplying information respecting the value and utilisation of such materials, and their cultivation and production. The number of reports completed in 1911 was 480, and at the end of the year 155 investigations were in progress. Details respecting these investigations are given under the heading of the subject to which they relate. The countries for which inves-

tigations have been conducted are:—Antigua, Bahamas, Barbados, Bermuda, British Guiana, British Honduras, British North Borneo, Canada, Ceylon, Commonwealth of Australia, Cyprus, East Africa Protectorate, Falkland Islands, Strait Settlements and Federated Malay States, Gambia, Gold Coast, Hong Kong, India, Jamaica, Mauritius, Newfoundland, New Hebrides, New Zealand, Northern Nigeria, Nyasaland, Papua, Rhodesia, Seychelles, Sierra Leone, Solomon Islands, Somaliland, Southern Nigeria, Sudan, Trinidad and Tobago, Uganda, Union of South Africa, Wei-hai-wei, Zanzibar. A large number of enquiries from commercial firms in the United Kingdom were also dealt with.

Minerals.

Countries of origin:—Cyprus, Sudan, Nyasaland, Uganda, East Africa Protectorate, Rhodesia, Union of South Africa, Gambia, Gold Coast, Northern Nigeria, Southern Nigeria, India, Ceylon, Federated Malay States, Commonwealth of Australia, Newfoundland, Canada, Trinidad, Bahamas, Jamaica, Seychelles, Falkland Islands, United Kingdom, Foreign Countries.

Mineral Surveys.

The Mineral Surveys in Southern Nigeria and Ceylon were continued during the year and considerable progress was made in the examination of mineral collections from these two countries, whilst the examination of those collected by the Mineral Surveys of Northern Nigeria and Nyasaland was completed and the first stage of the operations of these two Surveys brought to a conclusion. With the sanction of the Foreign Office, a Mineral Survey was also organised in the territory of the Mozambique Company in Portuguese East Africa.

Northern Nigeria.—A summary of the field work accomplished by the officers of the Survey during the years 1907-08 and 1908-09, together with the results of examination at the Imperial Institute of the specimens collected by the Surveyors, was published during the year in the Miscellaneous Series of Colonial Reports [Cd. 5899].

During 1907-08 important deposits of iron ore at Mount Patti, near the junction of the Niger and Benue rivers, were surveyed. The summit of Mount Patti is several square miles in extent and consists of bedded iron ores, which may be classified into three groups: (1) earthy iron ore; (2) dull concretionary ore; (3) compact and lustrous concretionary ore. The overburden is thin and the iron ore should be easily extracted so that these deposits ought to prove a valuable asset to the country in the future. Deposits of iron ore at Baro, Kurukuru and Mahorro were also examined. The best iron ore received was a sample obtained between Kachia and Kantiri, which consisted of magnetic iron oxide pebbles, containing the equivalent of nearly 66 per cent. of metallic iron, with only 1·25 per cent of silica, 0·9 per cent. of titanium dioxide, 0·007 per cent. of sulphur and no phosphorus. Detailed analyses of typical samples of all these iron ores are given in the Report already referred to.

Pegmatite carrying tinstone was discovered early in 1908 in the stream gravels in the Eri district and also as blocks, sometimes weighing several hundredweights, scattered over the hillside and on the plain. One specimen contained 20·5 per cent. of tinstone, equivalent to 16·1 per cent. of metallic tin. The quantity of tinstone-bearing pegmatite in this district is small and so far as is known would not pay for working, but the area merits detailed examination.

Numerous concentrates from rivers in the Ningi district were examined for the occurrence of tinstone. Those from the Kura river proved to be fairly rich in this mineral and in one case 67·20 per cent. was present. Gold was found in some of the concentrates, one from Birnim Gwari yielding 1 oz. 5 dwt. 11 grs. per ton. Monazite was present in most of the samples but in quantities that are negligible from a commercial standpoint. No very extensive deposits of limestone were located during 1907-08 but a number of occurrences of fairly pure limestones were observed. Some of these deposits occurred near shale or clay with which they might be used for the preparation of cement. Samples of clays, gypsum, phosphatic nodules, mica, &c., were also examined.

During 1908-09 a large number of concentrates were collected by officers of the Survey in various districts and tinstone was found to occur in considerable quantity in many of them. The most promising locality was the bed of the Kogin-Gingim, where tinstone had so far only been worked by natives. Concentrates from this source yielded 55·0 to 89·0 per cent. of tinstone and this area deserves thorough investigation. A tin-bearing sand from Gingim contained 1·31 per cent. of stannic oxide and would be worth working if the deposits prove extensive. Many of the concentrates contained considerable quantities of monazite, but not enough to repay working for this material alone, although it might be worth recovering as a by-product in working the gravels for tinstone. A specimen of lead ore from Bashar, Northern Muri, contained 53 per cent. of lead and 33 oz. of silver per ton, but no information is available yet as to the extent of this deposit, and the area requires further investigation.

A large number of iron ore samples were collected in 1908-09 but all contained too much silica or phosphoric oxide to be suitable for export.

A number of deposits of limestone of fair quality were located, the most important being that at Kumbri, which consists of nearly pure limestone containing only 5 per cent. of silica.

Southern Nigeria.—A report on the results of the examination of minerals collected by the Mineral Survey during 1908-09 was published in the Miscellaneous Series of Colonial Reports [Cd. 5901].

The lead and zinc ore deposits in the Abakaliki district, first examined by the Survey in 1905-06 have been further investigated, and new occurrences of these ores were found. The lodes have been extensively worked in the past by natives and a large amount of ore has been removed. Five bulk samples from the Amana section of the Ifotta lode, Alusi Hill, contained from 24·65 per cent. to 65·49 per cent. of lead and from 1 oz. 8 dwt.

2 grs. to 2 oz. 10 dwt. 15 grs. of silver per ton; a sample of blende-siderite ore from the same lode contained 30·40 per cent. of zinc. These Ifotta lead ores are distinctly poorer both in lead and silver than the ores found at Enyiba in 1907-08 and are of no value as silver ores.

Samples of iron ore were examined but the occurrences represented by them are of no importance. Special attention was paid to deposits of limestones and clays, and a series of the latter were submitted to pottery trials. A number of these limestones and clays could be used for cement making. Over 120 concentrates were examined. Many of these contained tinstone and monazite, but not in commercially important quantities.

Specimens accompanying the Interim Reports on the field results of the Survey during 1910 and 1911 were under investigation at the close of the year.

In the Report on the Work of the Imperial Institute for 1910 [Cd. 5467-23], reference was made to the work then in progress in connection with the important deposits of lignite and of sub-bituminous coal found in Southern Nigeria.

During 1908-09 the lignite deposits at Newi on the west bank of the Niger were examined by the officers of the Survey and the investigation of the deposits of sub-bituminous coal at Udi was commenced. The Newi lignite is of very good quality, but usually furnishes rather more ash than Okpanam lignite, and consequently has a somewhat lower calorific value.

Analyses were made of representative samples from the five seams of sub-bituminous coal located at Udi in 1908-09. This material is intermediate in character between lignite and true coal. The analyses show that it differs from the Southern Nigeria lignite chiefly in containing less water, less volatile matter, and more fixed carbon. The average calorific value of the samples examined in 1911 was about 6,500 small calories, which is practically identical with that of Okpanam lignite, briquetted under pressure, without admixture of a binding agent such as tar. The investigation of the deposits of these two kinds of fuel in Southern Nigeria by the Survey is still in progress, and a large number of samples from the various areas were under examination at the Imperial Institute at the end of 1911. Concurrently with this work firing trials with these fuels are being made both in Northern and Southern Nigeria. The work already done shows that in these deposits Southern Nigeria possesses assets that will be of immense value to the whole of West Africa.

Nyasaland.—A summary of the field operations carried out by officers of the Survey during 1908-09, together with the results of examination at the Imperial Institute of the more important specimens collected, is given in a Report published in the Miscellaneous Series of Colonial Reports [Cd. 5900]. Gold was discovered in the beds of the Dwangwa and certain of its tributaries. The richest concentrate examined contained 3 oz. of gold per ton, equivalent to a yield of about 9*d.* per cubic yard on the crude gravel. This yield might repay sluicing by natives.

Several deposits of good limestones were located which could

be used in conjunction with clay for making ordinary Portland cement. One sample contained too much magnesia, 5·28 per cent., to make cement of the first quality, but it occurs in a band over 100 yards thick and could be used if better material is not available in quantity.

A sample of graphite from M'komo was of very high grade, but it is doubtful if the deposit is extensive enough to repay working by Europeans. The graphite contained 99·23 per cent. carbon, 0·30 per cent. moisture and volatile matter, and 0·47 per cent. ash.

Argentiferous lead ore was located at Mulela's village. Two samples which probably represent the bulk of the available material contained 43·06 per cent. and 34·59 per cent. of lead respectively, whilst the amount of silver present was 5 oz. 8 dwt. 19 grs. and 4 oz. 7·dwt. 13 grs. per ton in the two specimens. They were valued at £3 4*s*. and £1 12*s*. per ton respectively, c.i.f. Cardiff (January, 1911).

Several good samples of iron ore were examined but the proportion of phosphorus or sulphur was rather high in some instances.

Several specimens of coal-like material were collected and forwarded, but only one sample could be described as a true coal. The remaining samples were mixtures of shale and coal, the former usually predominating.

Ceylon.—Reference was made in last year's report (p. 15) to the fact that arrangements had been made for continuing the Mineral Survey of Ceylon and for developing its work so that officers of the Survey could carry out prospecting work on a somewhat larger scale than hitherto. Work on these lines was commenced in Ceylon in March, 1911, and continued until August, 1911, when it had to be temporarily suspended owing to the serious illness of the Principal Mineral Surveyor and the death from enteric fever of the Assistant Surveyor. Work has, however, now been resumed. The material reported on during the year included a series of concentrates representing the alluvial deposits of the Weralupe Valley.

General.

Cyprus.—Eight samples of chrysotile asbestos were received. Three of the specimens were of fair quality and represented marketable material, but the fibres were rather short. The remaining samples were of inferior quality. A sample of "terre verte" was examined with a view to finding a market for it as a mineral pigment.

Sudan.—A sample of variegated marble suitable for decorative purposes was examined, and also specimens of iron smelted by natives, and of earthy limonite.

Uganda.—A specimen of brown hydrated iron ore was examined and found to contain 78·38 per cent. of iron oxide, equivalent to 54·9 per cent. of metallic iron, but it was highly phosphatic. A sample of micaceous clay rock, suitable for use with limestone in cement making but not plastic enough for pottery manufacture, was also received.

Samples of crude soda and "asphalt" were under investigation at the close of the year.

East Africa Protectorate.—Six samples of diatomite were received for examination. The best specimen contained 71·2 per cent. of soluble silica and was valued together with a second specimen at £3 to £3 10*s.* per ton, delivered in sacks at British ports, for material containing not more than 5 per cent. of moisture. The remaining samples would possibly be saleable at from £2 10*s.* to £3 per ton. The deposits represented by these samples are stated to be very extensive, and it is probable that the material may find a local use for roofing dwelling houses for Europeans as a protection against the tropical sun.

A sample of coaly shale proved to be of little value as a fuel owing to the large percentage of ash it yielded, but its occurrence in the Protectorate is of some interest, and the area in which it occurs would probably be worth further investigation with a view to the discovery of beds of true coal. Samples of bat guano, iron ore, and sand concentrates were also examined.

A sample of guano was under examination at the end of the year.

The examination of an extensive series of samples of soda, lake waters and spring waters from the soda lake at Magadi in East Africa was completed during the year. Analyses of samples of the rocks occurring near the lake were also made with a view to ascertaining the origin of the soda deposits. These materials were collected by the Geologist to the Anglo-Congolese Boundary Commission at the close of his work for the Commission in 1909.

Rhodesia.—The materials received for examination included 12 samples of gold ore. Four of these yielded enough gold to repay working, the best sample containing 1 oz. 10 dwt. 14 grs. per ton.

Union of South Africa.—A concentrate from the Transvaal was found to contain 95·52 per cent. of osmiridium (containing about 45 per cent. of iridium), 1·24 per cent. of gold, 0·61 per cent. of platinum, as well as a little iron and nickel. Other samples examined included graphite and brown umber from Natal.

Gambia.—Eight samples of iron ore were examined. The percentage of iron oxide in the best samples was 53·7, 49·43, and 46·74, equivalent to 37·61, 34·62, and 32·74 per cent. of metallic iron respectively. These ores might be suitable for local use but are too impure for export.

Gold Coast.—Three samples of petroleum were examined. In each case the oil consisted chiefly of high-boiling fractions and could be used as oil fuel and for the preparation of lubricating oil, whilst the residue left after distillation could be employed as asphalt.

Two samples of limestone proved to be of good quality.

Northern Nigeria.—In addition to the specimens received in connection with the Mineral Survey (*see* p. 16), samples of mica, concentrates, iron ores, &c., were also examined.

Southern Nigeria.—The work carried out in connection with the Mineral Survey of this Protectorate has been referred to already (p. 17). The search for petroleum referred to in the

last report (p. 19) was continued and 37 specimens of borings from wells were examined. Other materials examined included a mineral water and limestones.

India.—Three samples of monazite sand were examined. These contained 90·5 per cent., 62 per cent., and traces of monazite respectively. Other minerals received included galena, pyrolusite, corundum, a supposed wolfram concentrate, and a complex sulphide ore containing pyrrhotite, copper pyrites and molybdenite. At the close of the year a series of clays was under examination.

Ceylon.—Apart from the work done in connection with the Mineral Survey (p. 19) samples of thorite and of thorianite conglomerate were received. These contained respectively 58·1 and 33·29 per cent. of thoria. Small consignments represented by these samples were subsequently sold in London at £7 per unit, per cent. of thoria per ton.

Federated Malay States.—The examination of the tantalum mineral referred to in last year's report (p. 20) was completed. It proved to be a specimen of the rare tantalum mineral, strüverite. A complete analysis of the mineral has been published (*see Bulletin of the Imperial Institute*, Vol. IX. (1911), p. 354). Nine samples of "amang" were examined. Three of these contained 76·5, 67·8 and 62·35 per cent. of tinstone respectively. Monazite was present in all the samples, but only in small amounts.

A concentrate from Kedah contained 20 per cent. of tinstone and 40 per cent. of monazite, the latter containing 3·5 per cent. of thoria. At the close of the year a cerussite concentrate was under examination.

Commonwealth of Australia.—A radio-active ore was received from South Australia. It proved to be a siliceous iron ore consisting almost entirely of hæmatite and quartz with only a small percentage of uranium. A mineral received from Queensland contained 14·80 per cent. of copper and 9·97 per cent. of mercury. A sample of petrol distilled from shale in Tasmania was examined. It was of rather higher boiling point than petrol as used in Europe, but could be used as a solvent and under certain conditions as a fuel for internal combustion engines. Several samples of shales and limestones from Tasmania were received for examination as cement materials. Other minerals received for examination included pottery clays, kaolin and sand from Tasmania, sands and schists containing corundum from South Australia, limestone from Western Australia and chromite from Queensland. A collection of over 600 museum specimens of Australian minerals was examined and valued. Memoranda on the uses of tantalum in steel making and on the commercial uses and value of rutile were supplied to the Government of Western Australia.

West Indies.—Three samples of iron ore were received from Trinidad. One of these contained ferric oxide 84·46 per cent., ferrous oxide 11·89 per cent., together equivalent to 68·3 per cent. of metallic iron, only 1·85 per cent. of silica and traces of sulphur and phosphorus. It was valued at 20*s.* to 22*s.* per ton,

c.i.f. United Kingdom. Three samples of anthracitic coal from Bahamas were examined to ascertain their suitability for use in gas producers. A limestone which on burning would yield a lime suitable for mortar or agricultural purposes was also received from Bahamas. A sample of copper ore from Jamaica consisted chiefly of massive bornite and contained 25·4 oz. of silver per ton and about 50 per cent. of copper.

Seychelles.—Samples of calcite, pyrites and riebeckite were examined.

Falkland Islands.—A sample of copper ore containing 51·70 per cent. of copper oxide, equivalent to 41·25 per cent. of metallic copper, was valued at 9*s.* per ton, per unit per cent. of metallic copper.

United Kingdom.—A number of samples of minerals were submitted for identification by firms trading in this country, and many enquiries were also received with reference to the utilisation and occurrence of various minerals in the Colonies and India.

Foreign Countries.—The materials received for examination or identification included 30 samples of minerals and one sample of petroleum from H.M. Consul at Fez, lignite from Portugal and minerals from Norway and Sweden. The petroleum from Morocco was of very promising quality.

Six samples of nitrate shales from Egypt and a number of iron ores and other minerals from Broussa, Turkey, were under investigation at the close of the year.

A large number of samples of minerals were also examined in connection with the Mineral Survey of Mozambique.

Soils.

Countries of Origin:—Nyasaland, Uganda, East Africa Protectorate, Mauritius, Foreign Countries.

A large number of soils were received from Nyasaland and Uganda. These represented lands on which cotton had been grown successfully or had failed, and they were sent for examination with a view to ascertaining the physical condition and chemical composition of soils which had proved suitable for cotton in these countries. The results of this investigation have been published in the *Bulletin of the Imperial Institute,* Vol. X. (1912), p. 55.

A number of the soils proved to be deficient in constituents necessary for plant growth, and in these cases suitable manurial treatment was suggested.

Five samples of soils from the East Africa Protectorate were found to be deficient in nitrogen, and three of them contained notable amounts of alkali salts.

Four soils from Mauritius were examined as to their suitability for tobacco growing. They all contained notable quantities of soluble sulphates and consequently were probably unsuitable for cultivation of the best grades of tobacco without preliminary treatment, and suggestions as to suitable treatment were made.

Five samples from Mozambique were rather coarse in texture, and with one exception deficient in constituents necessary for

plant growth. The deficiency was least marked in the case of potash, which explains the promising quality of tobacco grown on the land from which these samples were taken.

Eight soils from Mozambique were under examination at the close of the year.

Fibres (Including Cotton).

Countries of Origin:—Sudan, Nyasaland, Uganda, East Africa Protectorate, Rhodesia, Union of South Africa, Gold Coast, Northern Nigeria, Southern Nigeria, India, Ceylon, Straits Settlements and Federated Malay States, Commonwealth of Australia, Papua, New Hebrides, West Indies, British Honduras, United Kingdom, Foreign Countries.

Cotton.

Sudan.—A sample of cotton grown from seed said to be of American origin was of good quality although rather irregular in length and strength. It was valued at 5⅜*d.* per lb., with "middling" American at 5¼*d.* per lb.

Nyasaland.—A sample of "Nyasaland Upland" cotton was of satisfactory quality and was sold at 12*d.* per lb., with "good" Abassi at 14¾*d.* per lb. and "middling" American at 8*d.* per lb. Eight samples of cotton and three of cotton seed were also examined. The American and Nyasaland Upland varieties were of fair quality and were valued at from 7⅝*d.* to 9½*d.* per lb., when "middling" American was quoted at 7·71*d.* and "good" Abassi at 13⅜*d.* per lb. Several samples of soils on which cotton has been grown were examined and reported on (*see* p. 22).

Uganda.—Thirteen samples were reported on during the year. A sample of ordinary Bukedi cotton was valued at 8*d.* to 8½*d.* per lb., with "middling" American at 8·05*d.* per lb., whilst two samples of hand-picked cotton of the same variety were valued at 9½*d.* per lb. on the same date. Two samples of Buddu cotton sent at the same time as the foregoing were somewhat stained and were valued at 8½*d.* per lb. A sample of Caravonica cotton was of good, harsh staple and valued at 11*d.* per lb., with "good" moderately rough Peruvian at 10·50*d.* per lb. The cultivation of this variety was not recommended owing to its tendency to harbour pests. Samples of improved American cottons were generally of excellent quality and valued at from 7·50*d.* to 9*d.* per lb., with "middling" American at 8·27*d.* per lb. Several samples of soils were received and examined as to their suitability for cotton growing (*see* p. 22).

Rhodesia.—A sample of Nyasaland Upland cotton was of greater strength than is usual in this variety and was valued at 7½*d.* to 8*d.* per lb., with "middling" American at 6·11*d.* per lb. A sample of Egyptian Mitafifi cotton was of uneven strength and length and was valued at 9*d.* per lb., with "fully good fair" brown Egyptian at 10*d.* per lb. Another sample of Egyptian cotton was valued at 10*d.* per lb., with "fully good fair" brown Egyptian at 11¾*d.* per lb. Three samples of American cottons were somewhat stained and weak and were

valued at 11*d.* to 12*d.* per lb., with "good" Abassi at 14½*d.* per lb.

Union of South Africa.—Five samples of Caravonica cotton grown in Zululand were examined. Four of the samples were of excellent quality and were valued at from 10½*d.* to 12*d.* per lb., with "good" rough Peruvian at 10·40*d.* per lb. The fifth sample was less harsh than is usual for this variety and resembled Upper Egyptian in colour. It was valued at 8*d.* per lb., with "fully good fair" Upper Egyptian at $9\frac{7}{16}d.$ per lb. Four samples of Caravonica cotton from Natal were of good strength and were valued nominally at from 9*d.* to 11½*d.* per lb., with good moderately rough Peruvian at 10·25*d.* per lb. A sample of Sea Island cotton from Natal proved to be of good quality, but rather irregular in length. It was valued at 11*d.* to 12*d.* per lb. with "fancy" Florida Sea Island at 13½*d.* per lb. Five samples of Egyptian Abassi cotton from Cape Province were examined. They proved of satisfactory quality and were valued at prices ranging from 11*d.* to 12½*d.* per lb., with "good" Egyptian Abassi at 14½*d.* per lb.

British West Africa.—A sample of Nyasaland Upland cotton from the Gold Coast was of uneven strength and slightly stained. It was valued at 8·67*d.* per lb. with "middling" American at 8·37*d.* per lb. A sample of native cotton was also received from the Gold Coast. It was strong and somewhat harsh but hardly rough enough to compete with rough Peruvian cotton, and was regarded as worth 0·3*d.* per lb. in advance of the current price of "middling" American. Ten samples of cotton from Northern Nigeria, produced in spacing and manurial experiments, were examined. They were found to be of good quality and were valued at from 8·06*d.* to 8·10*d.* per lb., with "middling" American at 7·96*d.* The spacing of the plants varied from 2 ft. by 2 ft. to 4 ft. by 3 ft., but this had no apparent effect on the quality of the lint. Another sample of cotton from Northern Nigeria was rough, curly and strong and would probably be useful for mixing with wool. It was valued at 9·10*d.* per lb., with "middling" American at 8·37*d.* per lb. Two samples from Southern Nigeria were also of good quality and were valued at from 8·47*d.* to 8·52*d.* per lb. on the same date. An insect pest of cotton in Northern Nigeria was received for identification. It proved to be *Sylepta derogata*, the cotton leaf roller. An ichneumon fly, parasitic on Sylepta, was identified as a species of *Xanthopinapla*.

India.—Four samples of cotton derived from *Gossypium arboreum*, L., var. *assamica*, Watt, were examined. They were very harsh and rough and slightly stained and were valued nominally at 5½*d.* to 5⅝*d.* per lb. with "fine" machine-ginned Bengals at 5⅜*d.* per lb. Eight samples of American cotton grown at Trichinopoly were of good quality, though some were lacking in lustre. They were valued at 6¼*d.* to 6⅜*d.* per lb., with "middling" American at 6·88*d.* and "fine" machine-ginned Broach at 6⅜*d.* per lb. Nine samples of seed-cotton grown at Mirpurkhas, Sind, were examined and reported on. Specimens of Egyptian Mitafifi and Abassi varieties were rather uneven in

length and were valued at 9*d.* and 10½*d.* per lb. respectively, with "fully good fair" brown Egyptian at 9⅞*d.* per lb. and "good" Abassi at 13¼*d.* per lb. A sample of native Sindhi cotton was of good quality but rather short. It was valued at 6⅝*d.* to 6¾*d.* per lb., with "fine" machine-ginned Bengals at 6 7/16*d.* per lb. Six samples of American Upland cottons were of excellent quality and would meet with a ready sale on the English market. They were valued at prices ranging from 7·50*d.* to 9·25*d.* per lb. with "middling" American at 7·75*d.* per lb. Two samples of American Upland type and twelve samples of native Indian types were received from the Central Provinces. The former were of somewhat uneven strength and were valued at 6¾*d.* to 6⅞*d.* per lb., with "middling" American at 7·51*d.* per lb. The native types were of good quality and unusually clean for Indian cotton. Their value ranged between 6⅜*d.* and 7¼*d.* per lb., with "fine" Oomra at 7⅛*d.* and "fine" machine-ginned Bengals at 6 7/16*d.* per lb. Six samples of native cottons from the United Provinces were valued at 6⅜*d.* to 6¾*d.* per lb., with "fine" Bengals at 6 7/16*d.* per lb.

Four samples of very satisfactory quality were received from Mandalay, Burma. They were valued at prices ranging from 7*d.* to 7¾*d.*, with "middling" American at 8·37*d.* and machine-ginned Broach at 7¾*d.* per lb.

Ceylon.—Five samples of Sea Island cotton were examined. Three were of rather poor quality, the chief defects being uneven staple and stains; they were valued at from 10*d.* to 11½*d.* per lb., with "choice" Georgia Sea Island at 15¼*d.* per lb. The other two samples were of better quality and were valued at 12¼*d.* and 13*d.* per lb. on the same date. A sample of "Abassi" Egyptian cotton was very irregular in length and badly stained; it was valued at 8½*d.* to 8¾*d.* per lb., with "fully good fair" Abassi at 12⅛*d.* A second sample was also of poor quality being nominally valued at 9*d.* to 10*d.*, with "good" Abassi at 13⅞*d.* per lb. A sample of Mitafifi proved to be of good value and would be readily saleable at about the same price as "fully good fair" brown Egyptian, which was then quoted at 10½*d.* per lb. Two samples of Caravonica cotton were of good quality and would sell readily at 9½*d.* and 10*d.* per lb. respectively, with good moderately rough Peruvian at 10½*d.* per lb. A sample of Cambodia cotton was of fairly good strength and of even length. It was valued at 7·00*d.* per lb., with "middling" American at 7·39*d.* and fine machine-ginned Broach at 7⅛*d.* per lb.

New Hebrides.—A sample of cotton, probably of the Caravonica variety, proved to be of very good saleable quality and was valued at 11½*d.* to 12*d.* per lb., with "good" Abassi at 14⅜*d.* and "good" rough Peruvian at 11·15*d.* per lb.

West Indies.—A sample of seed-cotton from Barbados was of excellent quality and appearance and very satisfactory in respect of length and fineness.

Foreign Countries.—Ginned and unginned samples of Sakellaridis cotton from Egypt were examined. This new and very promising variety was classed by experts as superior to best

Egyptian Yannovitch and was valued at 14½*d.* per lb., with "fine" Yannovitch at 13⅞*d.* per lb.

Samples of cotton from Asia Minor and Brazil were also examined.

Jute and Similar Fibres.

Sudan.—A sample of well-prepared jute was of very good strength with an average length of 4ft. 6 in. It was valued at £24 per ton in London when "first native marks" Calcutta jute was quoted at £25 per ton.

East Africa Protectorate.—A sample of "Kuyu-Ndigi" fibre, derived from *Triumfetta rhomboidea*, resembled jute, but was coarser and more interlaced. The sample examined consisted of gummy strips 2 ft. 6 in. to 4 ft. 6 in. in length and was of the nominal value of £10 per ton, but if properly prepared the fibre might find a market as a substitute for lower grades of Calcutta jute.

British West Africa.—Three samples of Hibiscus fibres from Gold Coast Colony proved to be rather interlacing and hence inferior to jute. The fibre of cultivated plants of *H. Sabdariffa* had an average length of 5 ft. 6 in. and was valued at £18 to £19 per ton, with "first native marks" Calcutta jute at £20 per ton. The fibre of cultivated plants of *H. cannabinus* was 6 ft. in length and valued at £17 to £18 per ton, whilst that from wild forms of *H. squamosus* was only 3 ft. 6 in. in average length, but was valued at £20 to £21 per ton, the greater value being due to better preparation of the fibre.

A fibre derived from an unidentified plant from Southern Nigeria was regarded as readily saleable as a jute substitute. It was valued at £19 per ton, with "first native marks Calcutta jute" at £20 15*s.* per ton.

Fibres Suitable for Cordage Manufacture.

East Africa Protectorate.—Two samples of diseased Sisal hemp leaves were received. The infecting fungus in each case was identified at Kew as *Colletotrichum agaves*, Sacc., and a memorandum was supplied giving information in regard to the necessary remedial measures.

Rhodesia.—A dried leaf of a species of Sansevieria and a small specimen of the fibre were examined. The latter was fine and strong but only 12 inches long and consequently of little commercial value. Two specimens of the fibre of the plant provisionally identified as *Sansevieria Pearsonii*, N.E.Br., were of good strength but rather short. One sample 2½ ft. to 4 ft. in length was valued at £20 per ton with "fair current" Manila hemp at £20 10*s.* per ton and best Sisal at £24 per ton; the second sample, 2 ft. to 2 ft. 9 in. long, was valued at £15 per ton.

Union of South Africa.—An unretted sample of hemp grown in Natal from indigenous seed was of good strength and 6 ft. in average length. If properly prepared the fibre would probably resemble Italian hemp which at the date of the report

(November, 1911) was quoted at the exceptionally high price of £60 per ton for "fair cordage quality, mark P.C."

British West Africa.—A sample of a bean fibre ("Binni") from Northern Nigeria was of good strength but only 2 ft. to 3 ft. long and lacking in lustre and elasticity. It was valued at £13 to £14 per ton, with "fair current" Manila hemp at £20 5*s.* per ton. Further samples of "Binni" fibre and products from Northern Nigeria were under investigation at the end of the year. A sample of "Aetiaeni" fibre (*Sansevieria*) from Northern Nigeria was received in a twisted and plaited condition. The fibre was fine and weak with an average length of 3 ft. 3 in. It would be worth, if not twisted, £17 to £18 per ton, with best Mexican Sisal at £25 per ton. A second sample, also twisted, was only 18 in. long and hence too short to be of much commercial value.

India.—A sample of the stem fibre of *Calotropis procera* was examined to ascertain its suitability for the manufacture of explosives. The sample had been over-retted and the presence of lignified barky matter rendered the material unsuitable for the purpose mentioned. Samples of Sisal fibre, Sida fibre, and Sisal tow were under examination at the end of the year.

Ceylon.—A sample of well-prepared Sunn hemp was of good strength but of poor colour and from 4 ft. 6 in. to 5 ft. 6 in. long. It was slightly inferior to a sample of Calcutta Sunn hemp with which it was compared and was valued at £19 10*s.* to £20 per ton (January, 1911).

West Indies.—Two samples of Agave fibre from Antigua were examined. In one case the fibre had been badly prepared, was very weak, and contained a large amount of sodium chloride. It was valued at £12 to £13 per ton with best Sisal hemp at £27 5*s.* The second sample was of good strength and was better prepared but contained 20 per cent of saccharine matter. It was valued at £18 to £19 per ton. By the exercise of greater care in preparing and washing the fibre, material of very good quality could be obtained.

Foreign Countries.—A sample of Sisal hemp of excellent quality from Mozambique was valued at £24 10*s.* per ton (November, 1911). Two samples of "Blue Zapupe" fibre from Mexico resembled the best Sisal hemp in appearance but were not quite so strong. They were valued at £19 to £20 and £25 to £26 per ton respectively. A sample of Manila hemp from Java was also examined.

Flosses.

The flosses or silk cottons are used chiefly as stuffing material for upholstery. Their utilisation has been extended recently however owing to the invention of a method of spinning them either alone or in admixture with cotton (see *Bulletin of the Imperial Institute*, Vol. IX. (1911), p. 70).

East Africa Protectorate.—A sample of *Gomphocarpus* floss was examined. It could be used for the same purposes as kapok but is not so resilient and hence would be of less value.

Union of South Africa.—Samples of the seed hairs of *Asclepias fruticosa* were received from Transvaal and Cape Province. The product would be saleable as a substitute for Java kapok and could also be used for spinning by the new process referred to above.

British Honduras.—A sample of kapok was found to be of poor colour and to contain much seed and fragments of capsule. It was valued at 2¼*d.* to 3*d.* per lb. in London (August, 1911).

Silk.

India.—A sample of pale yellow, raw silk from Mysore was of better quality than ordinary Bengal silks but inferior to those of China and Japan. It was valued at 13*s.* 6*d.* per lb. (May, 1911), and similar material should find a ready sale in Europe.

Miscellaneous.

Amongst other fibrous materials examined during the year were *Posidonia australis* fibre from Australia; coir from Northern Nigeria; leaves of *Agave heteracantha* from Mexico, which yield a brush fibre; beach moss from Ceylon; a species of Aristida (grass) from Transvaal, which was examined as a paper-making material; and "Cheyi" fibre and thread (*Polygala butyracea*) from Northern Nigeria, a fibre which might possibly compete with cotton and flax if obtainable in large quantities at a suitable price, whilst the seeds contain oil and might also be of commercial value.

A large number of enquiries were dealt with relating to the cultivation, preparation and utilisation of various fibres, information on these different points being supplied to merchants and others in the United Kingdom as well as to various Colonial Governments and to planters.

Rubber.

Countries of Origin:—Ceylon, India, Straits Settlements, Federated Malay States, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, Sudan, Uganda, Nyasaland, Rhodesia, Union of South Africa, Seychelles, Mauritius, Tobago, British Guiana, Bahamas, Portuguese East Africa.

Ceylon.—Seven specimens of Para biscuit rubber obtained in experimental tappings at Henaratgoda were analysed and found to differ only very slightly in composition. The percentage of caoutchouc present was uniformly high, ranging from 95·4 to 96·7 per cent. in the dry material. Three samples of Para rubber from the Experiment Station at Gangaruwa were also examined; two of them contained 94·0 per cent. of caoutchouc and the other 92·7 per cent.

Twenty-nine samples of Para rubber which had been specially prepared under the direction of the Ceylon Rubber Research Committee were examined and submitted to vulcanisation and tensile tests. The results of the experiments and certain tentative conclusions as to the value of various methods of preparing the rubber, together with suggestions for further experimental work, were embodied in a special report to the Committee.

A sample of *Manihot dichotoma* rubber from young trees was of very fair quality but rather deficient in strength.

India.—Five small samples of *Cryptostegia grandiflora* rubber from the Punjab were not large enough for detailed investigation; the rubber was however valued at 2*s.* 9*d.* to 3*s.* per lb. in London, with fine hard Para at 5*s.* 2½*d.* per lb. A sample of the same variety of rubber from Gwalior was of very fair quality, and was valued at 3*s.* 4*d.* to 3*s.* 6*d.* per lb. in London with fine hard Para at 4*s.* 8*d.* per lb.; similar material would be readily saleable in London, and if better prepared would command a higher price.

Straits Settlements.—Six samples of smoked Para rubber prepared at the Botanic Gardens at Singapore were found to vary considerably in composition, especially in the percentage of resin, which was in some cases excessive. This was found to be due to the cause mentioned in the report for 1910 (p. 25), viz., the inclusion with the resin of a certain amount of a saccharine substance present in the rubber.

The identity of this saccharine substance was investigated during the year with the above-mentioned samples and also with other samples of Para latex and rubber, which were specially forwarded from Singapore. The investigation showed that the substance in question was *laevo*-methylinosite, and that it was present in different specimens of the rubber in proportions varying from 1·0 to 2·7 per cent., whilst the latex contained 0·46 per cent. The presence of the substance in fine hard Para from South America was also proved. In analysing rubber prepared by the Brazilian or any similar method it is therefore necessary to take into account the possibility of substances other than resin being extracted on treatment with hot acetone.

Federated Malay States.—A sample of Para rubber which had been coagulated with acid, made into sheets, smoke-dried, and then pressed into block form, was found to be of excellent quality and to contain 95·9 per cent. of caoutchouc in the dry material. Tests by manufacturers showed that the rubber was of first-class quality and very durable, although not quite equal to fine hard Para.

Sierra Leone.—The coagulated latex of the "Tufui" tree (*Anthostema senegalensis*, Juss.) was found to be of very resinous nature, the dry material containing nearly 90 per cent. of resin and less than 6 per cent. of inferior caoutchouc. The product would have no commercial value at present.

Gold Coast.—A sample of Funtumia biscuit rubber prepared with formaldehyde, contained a little more resin and protein than is desirable, but was otherwise of good quality, and was valued at 6*s.* 10*d.* to 7*s.* per lb. in London with fine hard Para at 6*s.* 11*d.* per lb. A small consignment of Funtumia biscuit rubber prepared by the natives was also received, but it arrived in bad condition as the biscuits had been packed in a very moist state. It was sold in London at 3*s.* 6*d.* per lb., with fine hard Para at 4*s.* 9*d.* and Gold Coast lump at 1*s.* 8*d.* to 1*s.* 11*d.* per lb.

The roots and stems of two species of Salacia known locally as "Kplen" and "Tetso," and of *Hippocratea Welwitschii*, Oliv. ("Akradekpa" or "Akradefi"), were examined in order to

determine their value as sources of gutta. Only one of these plants, "Kplen," contained sufficient gutta to make extraction on a commercial scale worth consideration; the roots and stems of this plant contained respectively 11·35 and 2·10 per cent. of gutta which manufacturers stated might find a market at 1*s*. 6*d*. per lb. in London.

A further sample of "Diecha" juice, which is used as a coagulating agent for Funtumia latex, was examined but was found to have lost its coagulating action during transit. It appears probable that some alteration in composition occurs on keeping, and the constituents of the active juice can thus apparently only be satisfactorily investigated in the Colony.

At the request of the Imperial Institute botanical specimens of certain Hevea trees (supposed to be *Hevea Spruceana*) growing at Aburi were forwarded for determination, as it had been stated by M. Yves Henry that experiments with *Hevea Spruceana* in the Gold Coast and Southern Nigeria had shown that this species was more suitable for cultivation in West Africa than *H. brasiliensis*. The specimens were, however, determined at Kew as *Hevea brasiliensis*, Müll. Arg., and it therefore appears that the supposed *Hevea Spruceana* trees at Aburi, like those in Southern Nigeria, were wrongly named. M. Henry's opinion regarding the relative value of the two species in West Africa was therefore based on erroneous determinations.

Northern Nigeria.—A sample of block "balata" from the Bauchi Province contained equal proportions of caoutchouc and resin, and was valued at 1*s*. 8*d*. per lb. in Liverpool. The botanical origin of Northern Nigeria balata is usually stated to be *Ficus Vogelii*, and the sample corresponded in composition with specimens of the product of *Ficus Vogelii* from the Gambia and the Gold Coast previously examined at the Imperial Institute.

A sample of *Funtumia elastica* rubber from the Government plantation at Lokoja was too small for valuation or analysis, but it exhibited satisfactory physical properties and was evidently of very good quality.

Southern Nigeria.—A sample of Ceara rubber, prepared by the Lewa method and afterwards smoked, consisted of cakes formed of aggregated balls. The rubber was deficient in strength and consequently only of fair quality; it was valued at 4*s*. to 4*s*. 6*d*. per lb. in London, with fine hard Para at 6*s*. 11*d*. per lb.

A sample of *Funtumia elastica* rubber in biscuit form was of inferior quality on account of its unsatisfactory physical properties, probably owing to defective methods of preparation. Specimens of the same rubber in the form of small lumps, which were forwarded at the same time, were of much better quality, and were valued at 3*s*. per lb. in London, with fine hard Para at 4*s*. 1*d*. per lb.

Three samples of the rubber of *Ficus elastica* prepared by different methods were submitted for examination. Sample I. had been coagulated with carbonate of potash and dried in the smoke of burning palm kernels, whilst the other two were coagulated without potash, No. II. being dried in the smoke of burning palm kernels, and No. III. over a fire of green wood. The

three samples showed a progressive improvement in both composition and physical properties, containing respectively 89·6, 92·3 and 93·7 per cent. of caoutchouc. Samples II. and III. were of very good quality, and were valued at from 3*s*. 4*d*. to 3*s*. 6*d*. per lb. in London, with fine hard Para at 4*s*. 1*d*. per lb.; sample I., coagulated with potash, was weaker and less satisfactory in composition than the other specimens and was valued at a slightly lower price, viz., 3*s*. 4*d*. per lb.

Sudan.—A consignment of Landolphia biscuit rubber forwarded for sale from the Bahr-el-Ghazal was of very good quality and excellently prepared. It was divided into six lots, two of which were sold in London at 3*s*. 6*d*. per lb., and the remainder at 3*s*. 9*d*. per lb., with fine hard Para at 4*s*. 4*d*. per lb.

A smaller consignment of Landolphia biscuit rubber was forwarded from the Sudan to the International Rubber Exhibition in London, and was subsequently sold at 3*s*. 6*d*. per lb., with fine hard Para at 4*s*. 9*d*. per lb.

A consignment of Ceara rubber from Kugulu in the Lado district was of very good quality, consisting of light brown sheets which were clean and well prepared. The rubber contained 84·2 per cent. of caoutchouc, 6·5 per cent. of resin and 7·9 per cent. of protein. The consignment was sold in London at 4*s*. 9*d*. per lb., with fine hard Para at 4*s*. 8*d*. per lb. and plantation Para biscuits and sheet at 5*s*. 3*d*. per lb.

Uganda.—A sample of Ceara rubber prepared by simply diluting the latex with water and allowing it to stand was forwarded for comparison with a previous sample coagulated with lime juice. It consisted of light yellow corrugated sheet rubber which exhibited satisfactory physical properties. The dry rubber contained 89·3 per cent. of caoutchouc against 76·5 per cent. in the previous sample coagulated with lime juice, whilst the percentages of resin and protein were much lower than before. The rubber was much superior to the previous sample and was valued at 4*s*. 3*d*. to 4*s*. 6*d*. per lb. in London, with fine hard Para at 5*s*. 2*d*. per lb.

The "gutta" of *Chrysophyllum albidum* and *C. Kayei* from the Budonga and Bugoma forests was examined in view of the statement that a marketable product had been prepared from the latex of these trees. The "gutta" of *C. albidum* was found to contain 14·8 per cent. of resin, 78·5 per cent. of matter insoluble in chloroform, and only 2 per cent. of a sticky rubber-like substance, whilst that of *C. Kayei* contained only 0·8 per cent. of rubber-like substance; no true gutta was present in either sample. The results of the investigation showed that these "guttas" would have no commercial value in Europe.

Nyasaland.—Three samples of crêpe rubber, extracted by machinery from the underground stems of *Landolphia parvifolia*, were too small for chemical examination, but judging from their physical properties they appeared to be of good quality. The samples had been washed with water at different temperatures, viz., 68° F., 90° F., and 140° F., and of the three specimens the rubber washed with water at 90° F. appeared to be the most satisfactory, for although the sample washed with water at

140° F. was a little stronger it was slightly sticky. The specimens were valued in London at probably about 3*s*. 9*d*. to 4*s*., 4*s*. 2*d*. to 4*s*. 4*d*., and 3*s*. 11*d*. to 4*s*. per lb. respectively, with fine hard Para at 5*s*. 2½*d*. per lb. It was suggested that experiments should be carried out in Nyasaland with water at temperatures between 90° F. and 140° F. in order to obtain the best possible results.

Rhodesia—A sample of Ceara biscuit rubber from trees at Fort Jameson three and a half years old was of promising quality, although it contained a rather high percentage of protein. Consignments of similar character would probably realise from 4*s*. to 4*s*. 3*d*. per lb. in London, with fine hard Para at 5*s*. 3*d*. per lb.

A sample of "Mbongo" root rubber was received for examination together with botanical specimens of the shrub from which it was obtained. The latter was identified at Kew as *Clitandra henriquesiana*, K. Schum. The sample was too small for analysis, but was valued at 3*s*. 3*d*. to 3*s*. 6*d*. per lb. in London, with fine hard Para at 5*s*. 2½*d*. per lb. If carefully prepared this "Mbongo" rubber should realise a very fair price.

A sample of "Chimeya" rubber was in excellent condition and exhibited very satisfactory physical properties. The dry rubber contained 91·5 per cent. of caoutchouc and 6·6 per cent. of resin. The sample was valued in London at 4*s*. 9*d*. to 5*s*. per lb., with fine hard Para at 6*s*. 11*d*. per lb.

A sample of coagulated latex of unknown botanical origin was white, slightly sticky, and fairly tenacious, but exhibited little elasticity. The material resembled Borneo "Pontianak" in appearance.

Union of South Africa.—A sample of the "crude latex from the *Euphorbia Tirucalli*" from Natal contained 32·4 per cent. of moisture and was of very resinous nature, the dry substance containing 75·8 per cent. of resin and only 14·3 per cent. of "caoutchouc." The separated caoutchouc would probably be suitable for technical use, but its value could only be determined by the examination of a large quantity under manufacturing conditions.

Four other samples of coagulated Euphorbia latex from Natal were too small for analysis but were all of very resinous character and low commercial value.

A product of unknown botanical origin from the Transvaal consisted of a chocolate-coloured, pasty, sticky mass exhibiting none of the physical properties of true rubber. It was of very resinous character, the dry material containing 76·4 per cent. of resin and only 11·8 per cent. of a very inferior "caoutchouc."

Seychelles.—A sample of Para rubber, prepared from trees from five to seven years old growing at the Botanic Station in Seychelles, was of very good quality. The results of the analysis showed that the rubber was of very satisfactory composition, comparing favourably in this respect with plantation Para rubber from Ceylon and Malaya, and it possessed fairly good strength. The rubber was valued at about 7*s*. per lb. in London, with fine hard Para at 6*s*. 11*d*. per lb. and fine plantation Para at 6*s*. 11*d*. to 7*s*. 10*d*. per lb. The investigation confirmed

the view expressed in 1908 that the Para trees in Seychelles will yield rubber of excellent quality.

Tobago.—A sample of Castilloa rubber from trees six to seven years old growing in Tobago was in the form of a well-prepared large thin sheet; it was, however, extremely weak and contained 24·9 per cent. of resin. Similar material would realise only a low price in the United Kingdom.

Bahamas.—Two samples of *Cryptostegia grandiflora* rubber were forwarded from Nassau for examination. One of them, from vines three to four years old, was well prepared and exhibited good physical properties: it contained 89·2 per cent. of caoutchouc in the dry material. The second sample, from one-year old vines, was not quite so satisfactory in appearance and contained a lower percentage of caoutchouc, viz., 86·8. The first sample was valued in London at 3*s.* 10*d.* to 4*s.* and the second at about 3*s.* per lb., with fine hard Para at 4*s.* 4*d.* per lb. Rubber of similar character would be readily saleable.

Portuguese East Africa.—A sample of smoked Landolphia rubber from Mozambique was of good quality, the dry rubber containing 89 per cent. of caoutchouc and 9·4 per cent. of resin. The sample represented a consignment of rubber which was sold in London at 5*s.* 9*d.* per lb., with fine hard Para at 6*s.* 3½*d.* per lb.

Miscellaneous.—Numerous enquires regarding rubber and rubber cultivation were received during the year, and much information on the subject was furnished to Colonial Governments, British firms, and planters in various Colonies and Protectorates.

Oils and Oil Seeds.

Countries of Origin:—Sudan, Uganda, East Africa Protectorate, Rhodesia, Union of South Africa, Gambia, Gold Coast, Sierra Leone, Southern Nigeria, Northern Nigeria, India, Ceylon, Hong Kong, British North Borneo, Wei-hai-wei, Barbados, Mauritius, United Kingdom, Foreign Countries.

The more important oil seeds and oils examined were as follows:—

"*Baco*" or "*Abaku*" *Seeds.*—Botanical specimens of the plant yielding these seeds were received from the Gold Coast. They were identified at Kew as *Dumoria Heckeli*, A. Chev. In the report for 1910 (Cd. 5467-23, p. 29) it was shown that the kernels of these seeds are very rich in a solid white fat and are worth about £13 10*s.* per ton.

Bassia Seeds.—The investigation of a series of samples of kernels and fats derived from various species of Bassia was completed during the year and the results have been published in the "Bulletin of the Imperial Institute" Vol. IX. (1911), p. 228. The materials examined included the fruits, seeds, kernels and fat of *B. latifolia*, *B. longifolia* and *B. butyracea* from India and seeds and fat of *B. longifolia* from Ceylon. Bassia kernels are already used in Europe as a source of fat under the name of "Mowra" kernels, and this investigation is of commercial importance mainly as a means of determining the values of Bassia kernels from various botanical and geographical sources.

Different supplies of the kernels of *B. butyracea* yielded from 60·0 to 66·9 per cent. of white solid fat, and would be of greater value than those of *B. longifolia* or *B. latifolia*, which yielded lower percentages of somewhat softer fat. At present there appears to be no export of *B. butyracea* kernels from India, as all that are available are used locally for the production of edible fat. The *B. longifolia* kernels from India and Ceylon were superior to the "Mowra" kernels of commerce and were valued at £1 to £2 per ton in advance of the usual market price for this product. Bassia fat prepared by natives in Ceylon proved on examination to be of good quality and was valued at £32 per ton.

Beeswax.—A report was supplied to the Government of Northern Nigeria on samples of beeswax. The samples were valued at prices varying from £6 15*s.* to £7 10*s.* per cwt., with Jamaica beeswax at £7 5*s.* to £8 2*s.* 6*d.* per cwt. It was pointed out that there is a large demand for beeswax in the United Kingdom and that supplies equal in quality to these samples would sell readily.

A sample of Sudan beeswax was rather dirty and was valued at £6 7*s.* 6*d.* per cwt., *ex* warehouse, London. By re-melting and straining the value of this wax would be increased by about 7*s.* 6*d.* to 10*s.* per cwt. A second sample from the Sudan was valued at £6 12*s.* 6*d.* per cwt., less 2½ per cent. discount, *ex* warehouse, London.

Castor Seed.—Nine samples of castor seed from Uganda proved to be of good quality, the yield of oil being from 47·6 to 50·8 per cent. The seeds were valued at about the same price as Bombay castor seed, which was quoted at £12 5*s.* per ton at the date of the report (February, 1911).

Two samples from Mauritius yielded 45·2 per cent. and 45·5 per cent. of oil respectively, and were valued at £12 per ton in Hull (October, 1911).

A sample from the Sudan yielded 50·5 per cent. of oil and was valued at the same price as Bombay castor seed (£12 per ton in London, September, 1911).

At the end of the year samples of castor seed from the Sudan, East Africa Protectorate, &c., were under investigation.

Candle Nuts (Aleurites triloba).—A sample of unshelled candle nuts was received from Mauritius. The kernels yielded 68·1 per cent. of oil, which was valued at £28 to £30 per ton in Europe (October, 1911). The cake left after expression of the oil from the kernels could be utilised as a manure and for this purpose was valued at £1 10*s.* to £2 per ton.

Ground Nuts.—A sample of ground nuts grown experimentally in Gambia from Fiji seed consisted of large nuts of good appearance, and the kernels were valued at £14 10*s.* to £15 10*s.* per ton (March, 1911).

Ground nut oil from North-Eastern Rhodesia was of good quality and carefully prepared. Oil of similar quality would realise the highest price obtainable for ground nut oil in Europe.

Kpoye Nuts (Pycnanthus Kombo).—Samples of these nuts and of the fat extracted from them were received during the year

from Sierra Leone. The kernels yielded 70·7 per cent. of solid brown fat, which could be used for soap-making after being decolorised.

Lophira alata Seed.—A small consignment of *Lophira alata* kernels was received for technical trial from Sierra Leone. The kernels were expressed by a firm of oil seed crushers and the oil and cake examined. The kernels contained 40 per cent. of oil, and on the basis of this trial were valued at £10 per ton, c.i.f., Liverpool (December, 1911). The residual cake could be utilised as a manure for which purpose it would realise from £2 5*s.* to £3 per ton.

A sample of the seeds of *Lophira procera* was received from the Gold Coast and an investigation of the oil from the kernels was in progress at the close of the year.

Mafoureira Seeds.—Mafoureira seeds from Mozambique contained 56·6 per cent. of fat which could be used for soap-making. A sample of Mafoureira seeds from Portuguese East Africa was also examined.

Mahogany Seed Oil.—This oil, a sample of which was received for examination and valuation from Barbados, resembles soy bean oil and is suitable for the manufacture of soft soaps. It might also be utilised for mixing with linseed oil in the manufacture of paints. Its value was estimated at £26 per ton (July, 1911). It is not likely to be obtainable in commercial quantities at this price.

Oil Palm Products.—In continuation of the enquiry into the oil palm industry of West Africa referred to in last year's report (p. 30), nine samples of palm oils from various palm oil producing districts in Southern Nigeria were examined, and a report on the commercial grading of the samples was prepared. Three of the samples were classed as "soft" oils, four as "hard" oils, and two as "mixed" oils, *i.e.*, intermediate between the "soft" and "hard" oils.

Samples of palm kernels and palm nuts from Mozambique were also examined.

Senat Seeds.—A number of samples of the seeds of *Cucurbita Melo* var. *agrestis* were received from Sudan. The forms of this plant represented in the present series included those known locally as "Senat," "Hameid," "Fagus," and "Tibish." The seeds yielded from 29·5 per cent. to 36·5 per cent. of a pale yellow liquid oil, which was free from smell and taste and would be suitable for edible purposes. These seeds are stated to be fairly abundant in the Sudan and a small export trade in them has already been developed.

Soy Beans.—Five samples of soy beans were received from Sierra Leone. The yield of oil varied from 22·9 to 25·9 per cent., and the best samples would realise the market price of soy beans, viz., £7 3*s.* 9*d.* per ton (March, 1911).

An insect pest affecting soy bean at Wei-hai-wei was received for identification. It proved to be similar to the pea and bean beetles of this country and information was given as to the best means of eradicating it.

Sunflower Seed.—A sample of this seed was received from the Sudan. The kernels yielded 47·9 per cent. of oil, equivalent to about 22 per cent. expressed on the whole seed. The oil was bright yellow and somewhat viscous, and would be suitable for edible purposes after refining. The residual cake would be suitable for use as a feeding stuff. So far sunflower seed has not been largely worked in the United Kingdom as an oil seed, but experiments in its utilisation have been made recently in Hull.

Miscellaneous.—Other oil seeds received for examination included linseed from Rhodesia, *Mangifera indica* seeds from India, an oil seed probably derived from *Carpodinus hirsuta* from Southern Nigeria, whilst a number of specimens of new oil seeds were received for identification.

Numerous enquiries were received from merchants, planters and others interested in these products with reference to the cultivation and utilisation of various oil seeds. Many of these enquiries related to Para rubber seed oil, coconut oil, palm oil, cohune nuts and machinery for shelling oil seeds.

The investigations on oil seeds in progress at the end of the year in addition to those already mentioned included baobab seeds and ben oil seeds from the East Africa Protectorate, Shea butter and Shea kernels from Uganda and Gold Coast, *Telfairia pedata* seeds from Zanzibar, *Pentadesma butyracea* seeds from Southern Nigeria, a series of five oil seeds from Eastern Bengal and Assam, margosa seed from India and Ceylon, and an extensive series of oil seeds and oils from Hong Kong.

Volatile Oils.

Countries of Origin:—Cyprus, Sudan, Uganda, Nyasaland, East Africa Protectorate, Union of South Africa, Zanzibar, Northern Nigeria, Sierra Leone, Seychelles, India, Ceylon, Straits Settlements, Hong Kong, Commonwealth of Australia, United Kingdom, Foreign Countries.

Cyprus.—A sample of marjoram oil was received from Cyprus. It was similar in character to previous samples examined at the Imperial Institute, which were regarded as inferior to European marjoram oil and about equal in value to sweet fennel oil.

Sudan.—Botanical specimens of the Cymbopogon plant, referred to in the previous Annual Report [Cd. 5467-23], p. 31, as *C. Iwarancusa*, have now been identified as *C. senaarensis*, Chiov. The oil obtained from the grass by distillation was examined during the year and its principal constituent was found to be an aromatic ketone resembling pulegone in odour and general properties. The commercial value of the oil can only be ascertained after its exact composition has been determined, and this work is in progress.

East Africa Protectorate.—Specimens of coriander fruit were under examination at the close of the year.

Uganda.—The examination of the roots of *Chlorocodon Whiteii* referred to in last year's report (p. 31) was concluded. The root bark yielded 0·3 per cent. of odorous constituent as compared with 0·5 per cent. in a previous sample, whilst the

whole root yielded 0·2 per cent. The substance proved to be *p*-methoxysalicylaldehyde, and as it can be readily prepared artificially it would not be profitable to extract it commercially from Chlorocodon.

Union of South Africa.—A small consignment of "Sherungula" tubers was received. This was distilled and the essential oil obtained was under investigation at the close of the year.

Sierra Leone.—Examination of a further sample of the oil obtained from *Ocimum viride* confirms the opinion expressed in the previous report, p. 31, that the oil probably could not be profitably sold in Europe as a source of thymol in competition with other thymol-yielding oils.

Seychelles.—A sample of cus-cus or vetiver roots yielded on distillation 0·41 per cent. of vetiver oil of excellent quality. The roots were valued at £50 per ton, c.i.f., Hamburg.

India.—A sample of refined turpentine oil from Naini Tal proved to be similar in character to Russian oil and was valued by merchants at £30 to £40 per ton, and by varnish makers at £27 10*s.* per ton, *i.e.*, half the price of American oil.

Four samples of lemon grass oils were examined during the year. The percentage of citral varied from 72·5 to 84·5, and small consignments of these oils were sold subsequently in London at from 2¾*d.* to 3¼*d.* per oz. (February, 1911).

Information was supplied to the Government of Madras on the present production and market for vetiver roots, and a consignment of these roots from Madras was under investigation at the end of the year.

A memorandum was also furnished to the Forest Department in India on the market for borneol.

At the end of the year oil from the wood of *Cinnamomum glanduliferum* and a sample of lemon grass oil were under investigation.

Straits Settlements.—A sample of cloves was received during the year from Penang. It yielded 17·16 per cent. of volatile oil, containing 80·7 per cent. of eugenol.

Zanzibar.—Four samples of cloves prepared by drying in different ways were under investigation at the end of the year.

United Kingdom.—A number of enquiries were received from commercial firms in the United Kingdom, and in connection with these information was supplied on the production of lemon and other citrus oils with special reference to the British Colonies, on cardamon oil, camphor, linaloe oil, and various other products of this type. At the end of the year a series of essentials oils from Hong Kong was under examination.

Foodstuffs and Fodders

Countries of Origin:—Cyprus, Sudan, Uganda, East Africa Protectorate, Rhodesia, Union of South Africa, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, Mauritius, India, Ceylon, Hong Kong, Bermuda, British Honduras, United Kingdom, Foreign Countries.

Cereals.

Maize corn and maize cobs of the "white dent" variety were received from Sudan. The grain was large and of good merchantable quality and was valued at from 24*s*. to 24*s*. 6*d*. per quarter of 480 lb. (London, July, 1911).

Two samples of maize were also received from South Africa for determination of the amount of moisture present in the grain.

A good sample of unhusked rice was received from British Honduras, and as there is no market for unhusked rice in the United Kingdom a sample of the husked grain was asked for, and this was under examination at the end of the year.

Specimens of diseased wheats and other cereals from the East Africa Protectorate were received for identification of the diseases. Most of the specimens were attacked by *Puccinia graminis* (wheat "rust"), and other fungi present included *Phyllachora graminis*, *Epicoccum* sp., and *Helminthosporum* sp.

At the end of the year samples of maize from Southern Nigeria were under investigation.

A large consignment of dura grain from the Sudan was also under investigation as a raw material for the manufacture of starch, glucose, alcohol, and other products, whilst arrangements had also been made for feeding trials with this material as a substitute for maize. The flour contained in the seeds of *Musa Livingstonii* from the East Africa Protectorate was also under investigation.

Leguminous Seeds.

A sample of "dhall" seeds (*Cajanus* sp.) from Ceylon was examined, and valued as a feeding stuff at £6 10*s*. per ton (London, October, 1911). A sample of "seven-year" beans from the East Africa Protectorate was analysed and found to be of satisfactory composition. Herbarium specimens of varieties of beans from the Sudan, "butter beans" from Mauritius, and "mutter" peas were received for identification. An extensive series of samples of beans from Hong Kong was under examination at the close of the year.

Coffee and Cocoa.

In connection with experiments on the preparation of cocoa beans in the Gold Coast Colony five samples which had been prepared in different ways were received for valuation. The broker's valuations varied from 50*s*. to 55*s*. per cwt. in London, and from 45*s*. to 51*s*. per cwt. in Liverpool (March, 1911), the highest prices being quoted for beans which had been fermented for eight days and washed.

Two samples of cocoa beans from Sierra Leone were valued at 53*s*. and 54*s*. per cwt. respectively in Liverpool (October, 1911).

Three samples of coffee from Uganda were awaiting investigation at the end of the year.

Miscellaneous.

Samples of Bermuda arrowroot were examined with a view to finding a simple means of distinguishing Bermuda arrowroot from less valuable varieties.

Several insect pests of the sugar cane and other cultivated plants were received from Mauritius and Northern Nigeria for identification; methods for the extermination of the pests were recommended in each case.

A large number of enquiries with regard to the cultivation, preparation and marketing of foodstuffs were dealt with. Many of the enquiries related to the production of starch from dried bananas, cassava, potatoes, horse-chestnuts and other starchy materials. Other enquiries related to the feeding value of new or little known oil-cakes, *e.g.*, rubber seed cake, radish seed cake, &c.

At the close of the year samples of cassava from Southern Nigeria, dates from the Sudan, ginger from Hong Kong, and mafoureira seed cake from Mozambique were under investigation.

Tobaccos.

Countries of Origin:—India, Ceylon, Uganda, East Africa Protectorate, Union of South Africa, Mauritius, United Kingdom, Foreign Countries.

A sample of tobacco from India was of marketable quality, but only for cutting as a pipe tobacco, for which purpose it was valued at 7*d.* per lb. A sample of flue-cured cigarette tobacco from India was valued at 8*d.* per lb. Eight tobaccos of various cigar types from Eastern Bengal and Assam were also examined. These were of satisfactory composition but of rather poor colour and aroma and consequently could only be used in the United Kingdom as "cutting" tobaccos, for which purpose they were valued at 4½*d.* to 6½*d.* per lb.

A number of samples of cigar tobaccos and cigars were also received from Ceylon and reported on. Complete analyses of a selected number of the Ceylon tobaccos were made and valuations of all the tobaccos and cigars were obtained. The samples in part represented the produce of a large scale tobacco-growing trial carried out in 1910-1911 by the Ceylon Agricultural Society.

Samples of Turkish tobacco grown in Uganda were examined. This was of inferior quality and a small consignment of it was sold at 4*d.* per lb. in the United Kingdom. A memorandum on tobacco cultivation was supplied to the Government of Uganda.

Two bales of Turkish tobacco from Cape Province were received for experimental sale in continuation of the enquiry mentioned in last year's report (p. 35). The tobacco was of excellent quality and similar to some grades of Smyrna tobacco. It was valued in the United Kingdom at 1*s.* 6*d.* per lb. but would probably realise higher prices in South Africa.

Samples of pipe tobacco from the East Africa Protectorate proved to be not well prepared, but chemical examination of the tobacco indicated that it was of satisfactory composition and that the tobacco would be saleable if properly prepared.

Samples of tobacco and cigars received from Mauritius were examined, and also four samples of soils on which it was proposed to grow tobacco (*see* p. 22).

An extensive series of Virginian, Levantine and cigar types of tobaccos grown experimentally in Mozambique were reported

on. These were all of promising quality, and the Virginian tobaccos were valued at 4*d.* to 8*d.* per lb.

A number of enquiries on various aspects of tobacco cultivation were also dealt with.

Gums and Resins.

Countries of Origin:—Sudan, Somaliland, Nyasaland, Uganda, East Africa Protectorate, Rhodesia, Gold Coast, Northern Nigeria, Southern Nigeria, India, Ceylon, Federated Malay States, Commonwealth of Australia, United Kingdom, Foreign Countries.

A sample of rosin from India was examined. The material was prepared by clearing with alum and was of good quality, being valued by merchants at £14 to £15 per ton and by soap-makers at £13 per ton.

Among the other products of this kind examined were *Canarium bengalense* resin from India, *Gardenia latifolia* resin from Ceylon, and Xanthorrhœa resin from Tasmania.

Information was supplied to the Governments of the Anglo-Egyptian Sudan and the East Africa Protectorate with reference to the gum arabic industry, and samples of this gum from Nyasaland, Uganda, and Rhodesia were received and reported on.

The materials under investigation at the close of the year included oleo-resin of *Daniella thurifera* from the Gold Coast and Northern Nigeria, resin of *Pinus longifolia* from India, sap of the Kruing tree from Federated Malay States, Burmese black varnish from India, and copal from Mozambique. An extensive series of resins, gum-resins and gums collected by Dr. Drake-Brockman in Somaliland was also under investigation. This collection includes authenticated specimens of myrrh, olibanum and other materials.

Drugs and Poisonous Plants.

Countries of Origin:—Sudan, Nyasaland, East Africa Protectorate, Rhodesia, Union of South Africa, Sierra Leone, Gold Coast, Northern Nigeria, India, Ceylon, Federated Malay States, Hong Kong, Canada, West Indies, Commonwealth of Australia, United Kingdom, Foreign Countries.

Union of South Africa.—Considerable progress was made during the year in the examination of plants reputed to be poisonous to cattle in South Africa. The investigation of the physiological action of the constituents of *Senecio latifolius* from Cape Province carried out by Dr. Cushney, F.R.S., of University College, London, was completed. The two alkaloids, senecifoline and senecifolidine, present in the plant, were found to be poisonous to animals, and the symptoms produced by them so closely resemble those in cattle and horses suffering from "Molteno disease" that there can be no doubt that the latter is really chronic poisoning by Senecio alkaloids (see *Bulletin of the Imperial Institute*, Vol. IX. (1911), p. 346).

An examination was made of the roots of *Mesembryanthemum Mahoni* received from Transvaal. The dried roots are used in

South Africa instead of yeast for fermenting bread and in the preparation of alcoholic beverages. The fermenting action was found to be due to the presence of a fungus, which is being further investigated. The roots also contained oxalates equivalent to about 3 per cent. of oxalic acid, and in view of this the plant cannot be recommended as a substitute for yeast in bread making. A similar plant, identified at Kew as *M. stellatum*, was received for examination from Cape Province.

Other South African drugs and poisonous plants still under investigation are *Dichapetalon cymosum* leaves, *Acokanthera venenata*, *Crotalaria Burkeana*, *Leonitis leonurus*, and *Homeria pallida* from Transvaal Province, "slangkop" bulbs and leaves from Cape Province, and *Chrysophyllum viridifolium* bark from Natal.

British West Africa.—Samples of kola nuts derived from *Cola acuminata*, *C. Johnsoni*, and *C. verticillata* from the Gold Coast were examined and found to contain 1·7, 0·7 and 0·7 per cent. of total alkaloids, respectively, expressed on the fruits dried at 100° C. They were all valued at 1½*d.* to 2*d.* per lb.

The examination of native drugs from Sierra Leone was continued. The material known as "Ebonka," the botanical source of which is uncertain, though possibly *Paullinia pinnata*, was found to contain only a trace of alkaloid, and physiological trials indicated that the leaves are probably of no medicinal value. The drugs from Sierra Leone still under investigation include "Anet," "Tatuookroo" and "bitter leaf plant." Botanical specimens of the last-mentioned were identified at Kew as *Vernonia amygdalina*.

A drug known as "Gigeya" in Northern Nigeria, where it is used as a febrifuge, is still under examination.

India.—The investigation of a large number of samples of opium collected in the chief opium districts of India was completed during the year and a full report on the results obtained is now in preparation.

In connection with the investigation of Indian Solanaceous drugs samples of the leaves and stems of *Hyoscyamus niger* and of the capsules and seeds of *Datura Metel* were examined. The hyoscyamus leaves and stems contained respectively 0·062 and 0·081 per cent. of total alkaloid. The *Datura Metel* seeds contained 0·23 per cent. of total alkaloid consisting of hyoscyamine and scopolamine in the proportion of 2 : 1, together with a little atropine; the capsules contained 0·10 per cent. of total alkaloid consisting of scopolamine only.

Two samples of *Podophyllum Emodi* roots from the North West Provinces, India, were examined. The amount of total resin in the samples was 11·07 and 11·7 per cent. respectively, expressed on the material as received; the proportion of podophyllotoxin was in the first case 4·7 per cent. and in the other sample 3·1 per cent.

Thirteen other samples of Indian drugs were received and reported on. *Thalictrum foliolosum* and the seeds of *Peganum Harmala* and *Schleichera trijuga* were under investigation at the close of the year.

Ceylon.—Two samples of "Truxillo Coca" leaves (*Erythroxylon Truxillense*, Rusby) from Ceylon were examined. They contained 1·02 per cent. and 0·51 per cent. of "ether-soluble alkaloids" respectively, and were valued at about 8*d.* to 9*d.* and 5*d.* to 5½*d.* per lb. respectively.

Federated Malay States.—A sample of "Truxillo Coca" leaves was also received from the Federated Malay States. This contained 1·25 per cent. of "ether-soluble alkaloids," and was valued at 1*s.* 2*d.* per lb. in London with "fair green Ceylon Huanuco" leaves at 1*s.* 3*d.* to 1*s.* 7*d.* per lb. and "ordinary brownish" leaves at 7½*d.* per lb.

Miscellaneous.—A considerable number of drugs other than those already mentioned were under investigation at the close of the year. These included *Leonitis pallida* from Sudan, a medicinal root from Nyasaland, *Croton Elliottianus* seed from East Africa Protectorate, *Tephrosia Vogelii* seeds and leaves from Rhodesia, *Adhatoda vasica* leaves from Ceylon, *Homeria* spp. from South Australia, *Daphnandria micrantha* bark from New South Wales, *Senecio Jacobaea* from Canada and the United Kingdom, and "mudata" bark from Mozambique.

In addition various enquiries on the sources of drugs and the cultivation of drug-yielding plants were dealt with, and a memorandum was supplied to the Government of Northern Nigeria on the use of *Tephrosia Vogelii* as a fish poison.

Tanning Materials and Dyes.

Countries of Origin:—Cyprus, Sudan, East Africa Protectorate, Union of South Africa, Southern Nigeria, Sierra Leone, India, Ceylon, Federated Malay States, Hong Kong, United Kingdom, Foreign Countries.

Sudan.—The materials awaiting investigation at the close of the year included sant pods and the bark of *Anogeissus leiocarpus.*

East Africa Protectorate.—A sample of wattle bark from the East Africa Protectorate was examined. It was of good quality containing 39·2 per cent. of tannin, and was valued at £8 per ton in London, with Natal wattle bark at £6 5*s.* to £10 per ton. A memorandum on the present production of tanning materials was supplied to the Forestry Department of the East Africa Protectorate. At the close of the year two samples of wattle bark were under investigation.

Union of South Africa.—A sample of *Acacia arabica* var. *Kraussiana* pods was under investigation at the end of the year.

Southern Nigeria.—The bark of *Anogeissus leiocarpus* was examined but the amount of tannin present, 17·1 per cent., is too small to permit of the bark being exported to Europe. Four samples of mangrove bark were reported on during the year and five more are still under investigation. Various herbarium specimens of trees yielding camwood were received for identification.

India.—Twelve sample of mangrove, "sal" and "teri" extracts made at the Government factory, Rangoon, were examined. The mangrove extracts were all rich in tannin but

rather dark in colour. The best of the samples, if decolourised, would be worth about £15 per ton in the United Kingdom. A further sample of mangrove extract from Burma was of excellent quality, but the quantity was too small to admit of commercial valuation.

Ceylon.—Samples of the wood and bark of *Terminalia glabra* from Ceylon were received for examination. The latter contained 31·6 per cent. of tannin and 5·8 per cent. non-tannin extractive matter, and the examination of a further sample was in progress at the end of the year.

Hong Kong.—A sample of Chinese gall-nuts was under examination at the end of the year.

United Kingdom.—A number of enquiries from persons and firms in the United Kingdom were received in regard to the cultivation and utilisation of tanning materials, including wattle bark, mangrove bark, gambier, *Cæsalpinia digyna* pods, &c.

Timbers.

Countries of Origin:—Uganda, East Africa Protectorate, Rhodesia, India, New Zealand, West Indies, British Guiana, United Kingdom.

A series of nine timbers from Uganda was examined. Three of these, *Entandrophragma Angolense*, D.C., *E. utile*, Sprague, and *Khaya anthotheca*, C.DC., were African mahoganies of good quality and would be readily saleable in the London market at the same prices as mahogany from West Coast of Africa, which realises on the average 3*s.* per cubic foot in logs, 24 to 36 inch square, and 14 feet or more in length. The remaining timbers would be valuable locally, but would not be saleable in London at remunerative prices.

A specimen of the "giant heath" wood from East Africa Protectorate was sent for trial for pipe manufacture. It was found to be unsuitable for this purpose on account of the deep cracks and crevices it contained.

Various woods of low specific gravity from British Guiana were examined as materials for the manufacture of explosives. "Duka" timber (*Tapira* sp.) from the same Colony was found to be suitable for second quality cigar boxes or as a mahogany substitute. For the latter purpose it was valued at 2*s.* 6*d.* per cubic foot in planks.

Samples of West Indian satinwood were under investigation during the year with a view to ascertaining whether they contained irritant substances similar to these present in East Indian satinwood. The investigation of the latter has now been completed with the publication in 1911 of a paper by Dr. Cash, F.R.S., of Aberdeen University, describing the pharmacological action of the alkaloid, resins and other substances isolated from the East Indian satinwood in this department in 1909. A summary of the chief results of this investigation was published in the *Bulletin of the Imperial Institute*, Vol. IX. (1911), p. 351, and a similar investigation is now in progress with the West Indian wood.

A number of enquiries were dealt with concerning the utilisation of various timbers, the production of timber in British Colonies and the identification of specimens.

Miscellaneous Products.

Countries of Origin:—Cyprus, Sudan, Nyasaland, Uganda, East Africa Protectorate, Rhodesia, Union of South Africa, Sierra Leone, Northern Nigeria, Southern Nigeria, India, Ceylon, Hong Kong, Solomon Islands, United Kingdom, Foreign Countries.

In this section are included a number of enquiries which do not readily fall into any of the classes of products already dealt with.

They included specimens of locusts sent from Cyprus for identification, pitch prepared from mangroves in Mozambique, "bemba kofi" seeds from East Africa Protectorate, &c. A sample of tea-seed cake from Hong Kong proved to be rich in saponin, and a use has been found for this material for horticultural purposes. A number of enquiries were also received regarding the utilisation of "deleib" and "dum" palm nuts as vegetable ivory. A memorandum was supplied to the Government of India on the preparation of loofahs for the European market. A large number of enquiries in this class referred to the identification of samples of Colonial and Indian raw materials submitted by firms in the United Kingdom.

Animal Products.

Countries of Origin:—Sudan, Somaliland, Union of South Africa, India, Hong Kong, Commonwealth of Australia, Papua, West Indies.

The materials examined included mother-of-pearl shells and ostrich feathers from Sudan, sponges from Somaliland and South Australia, and "lapi" pearl shells from Papua. Memoranda were supplied to the Government of India on the commercial value of rat skins, and to the Government of the Union of South Africa on the utilisation of sharks' fins, tails, skins, &c. At the close of the year glue and leather from Hong Kong were under examination.

General Enquiries.

The foregoing sections describing the work of the Scientific and Technical Department relate mainly to materials submitted for investigation through official channels, or samples forwarded by merchants for identification. In addition to this class of work an increasing number of enquiries of a commercial character, involving scientific and technical questions, is now being received each year. These enquiries are chiefly of two classes: (1) requests for advice from officials of technical departments in the Colonies and India as to the cultivation of new products, the commercial value of little known materials, or methods of marketing produce, and (2) requests from merchants and manufacturers chiefly in the United Kingdom for information as to new sources of raw

materials, advice regarding the production of raw materials in the Colonies, &c.

The number of such enquiries in 1911 was 386, exclusive of those relating to settlement, emigration and other similar matters, referred to elsewhere. A large proportion of these enquiries concerned food-grains and feeding-materials, and oil-seeds and oils, principally, no doubt, as the result of the dearness of these particular raw materials in 1911. An increasing proportion of these general enquiries relates to problems of tropical agriculture and forestry, special interest being shown in 1911 in the cultivation of the following products, rubber, cotton, tobacco, coconuts, oil palm, coarse fibres, soy beans, linseed, ground-nuts, tropical fruits, and camphor.

As has been already stated numerous enquiries of a similar character have been received regarding minerals.

VIII.—SUBSIDIARY WORK.

During the year meetings, &c., were held by the African Society, the Anglo-Russian Literary Society, the Aerial League of the British Empire, the Australian League, the British Women's Emigration Association, the Colonial Nursing Association, the Imperial Order of the Daughters of the Empire, and the London Needlework Guild.

In connection with the Coronation celebrations several receptions, conversaziones, &c., were held at the Imperial Institute. The High Commissioner for the Commonwealth of Australia, Sir George Reid, held a reception in honour of the delegates from the Commonwealth and States of Australia on the occasion of the Coronation. A reception of the Commonwealth delegates was also held by the Australian artists in London. The Dominion Day Dinner and Reception were given at the Imperial Institute by the High Commissioner for Canada, Lord Strathcona, at which H.R.H. the Duke of Connaught, the Duchess of Connaught, and other members of the Royal Family were present. A conference of the Victoria League to meet delegates from the Home and Oversea Branches and Allied Associations for the reading and discussion of papers was also held at the Imperial Institute.

By command of Their Majesties the King and Queen the Royal Coronation Robes were exhibited at the Imperial Institute from the 10th to the 20th July. Over 25,000 people visited the exhibition, and the proceeds of the small charge for admission were given to the funds of the Princess Louise's School of Needlework (Ladies' Work Society) at the request of Their Majesties.

The Imperial Order of the Daughters of the Empire was given the use of a room on the mezzanine floor for office purposes in view of the visit of large numbers of the members of the Order to this country on the occasion of the Coronation.

A memorial exhibition of some of the works of the late Mr. Henry Sandham, Royal Canadian Academician, including oil and water colour paintings, drawings, etchings and designs, was held in the Upper West Gallery.

Accommodation was provided at the Imperial Institute for the meetings of an Imperial Temperance Conference, and for a reception by the National Temperance League in connection with the Conference.

A portion of the North Gallery was lent temporarily to the City and Guilds of London Institute for the examination and display of the work executed by the candidates at the Institute's technological examinations.

A portion of the North Gallery was lent, at the request of the Board of Trade, to the Royal Commission for the International Fine Arts Exhibition at Rome for the selection, by a committee, of pictures for despatch to that Exhibition, and later, for the reception and redistribution of the pictures returned from the Exhibition.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
708	Uganda	1910–1911
709	Straits Settlements...	1910
710	Basutoland	1910–1911
711	Leeward Islands	„
712	St. Vincent	„
713	St. Lucia	1910
714	St. Helena	1911
715	Weihaiwei	„
716	Ceylon	1910–1911
717	Gibraltar	1911
718	Gambia	„
719	Ashanti	„
720	Falkland Islands	„
721	Seychelles	„
722	Northern Territories of the Gold Coast...	„
723	Hong Kong	„
724	Sierra Leone	„
725	Gold Coast	„
726	Turks and Caicos Islands	„
727	Fiji	„
728	Bechuanaland Protectorate	1911–1912
729	Basutoland	„
730	Colonial Survey Committee	„
731	Malta	„
732	Nyasaland	„
733	British Honduras	„
734	Gilbert and Ellice Islands...	1910
735	Southern Nigeria	1911
736	Somaliland	1911–1912

MISCELLANEOUS.

No.	Colony, &c.	Subject.
71	Imperial Institute	Foodstuffs.
72	Fiji	Hurricane, 1910.
73	Jamaica	Cayman Islands.
74	Ceylon	Mineral Surveys, 1906–7 and 1907–8.
75	West Indies	Imperial Department of Agriculture.
76	Southern Nigeria	Mineral Survey, 1907–8.
77	St. Vincent	Roads and Land Settlement Fund.
78	Weihaiwei	Census, 1911.
79	Northern Nigeria	Mineral Survey, 1907–8 and 1908–9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.

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COLONIAL REPORTS—ANNUAL.

No. 778.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, 1912.

(For Report for 1911, *see* No. 737 [Cd. 6007-37] of 1912.)

Presented to both Houses of Parliament by Command of His Majesty.
December, 1913.

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By DARLING AND SON, LTD., BACON STREET, E.

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No. 778.

IMPERIAL INSTITUTE, 1912.

(For Report for 1911, *see* No. 737 [Cd. 6007–37.] of 1912.)

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE IN 1912. BY PROFESSOR WYNDHAM R. DUNSTAN, C.M.G., M.A., LL.D., F.R.S., *Director*.

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I.—PREFATORY STATEMENT.

THE IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA.

Trustees.

The First Commissioner of His Majesty's Treasury.
The Secretary of State for the Colonies.
The Secretary of State for India.
The President of the Board of Trade.

List of Advisory Committee in 1912.

(Appointed under the provisions of the Imperial Institute Transfer Act, 1902.)

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Sir A. E. Bateman, K.C.M.G. (nominated by the Board of Trade).
Colonel D. G. Pitcher (nominated by the India Office).

Director.

Professor Wyndham R. Dunstan, C.M.G., M.A., LL.D., F.R.S.

The Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May, 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire

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by arranging comprehensive exhibitions of natural products, especially of the Colonies and India, and providing for their investigation and for the collection and dissemination of scientific, technical and commercial information relating to them.

The work of the Imperial Institute is at present carried on under four principal divisions: (1) the Colonial and Indian Collections, consisting mainly of raw materials and primary manufactures displayed in the public exhibition galleries, and including a Central Stand for receiving enquiries and distributing publications; (2) the Scientific and Technical Department, including a special staff, and research laboratories, occupying the second floor of the building and parts of the first floor and basement; (3) the Reference Library, containing a large collection of works of reference relating to the Dominions, Colonies and India, together with the principal periodicals and newspapers; (4) the "Bulletin of the Imperial Institute," a quarterly publication containing a record of the work of the Imperial Institute in its various branches, as well as special articles on progress in tropical agriculture and industries and the commercial utilisation of the natural resources of the Colonies and India.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which His Royal Highness the Prince of Wales (afterwards King Edward VII.) was President, and an Executive Council, including representatives of the Indian Empire, and of all the British Colonies and Dependencies. In 1900 the building became the property of His Majesty's Government, by whom the western portion of the main building and the galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portion of the main building being assigned, subject to rights of usage, for occupation by the University of London. In July, 1902, an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee, including representatives of the Dominions, Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A committee of management of three members, one nominated by each of the three Government departments chiefly concerned, has been appointed, and at present consists of Mr. C. A. Harris, C.B., C.M.G., M.V.O., Sir Alfred Bateman, K.C.M.G., and Col. Duncan Pitcher (late Indian Army).

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, C.M.G., M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and the commercial utilisation of economic products.

The following are the principal departments of the Institute:—

Colonial and Indian Collections.—The collections of economic products, etc., illustrative of the general and commercial resources of the Dominions, Colonies and India are arranged, together with other exhibits, on a geographical system in the public exhibition galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday, and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter.

The following British Dominions, Colonies and Dependencies are represented by collections, which are in charge of technical superintendents:—

Canada, Newfoundland, Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahamas, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda, Falkland Islands, New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, Papua, New Zealand, Fiji, Western Pacific Islands, Union of South Africa, Rhodesia, Nyasaland, St. Helena, Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, East Africa Protectorate, Zanzibar and Pemba, Uganda, Somaliland, the Anglo-Egyptian Sudan, Malta, Cyprus, Ceylon, Hong Kong, Mauritius, Seychelles, Straits Settlements and Federated Malay States, India.

Special arrangements are made to conduct parties from schools and institutions through the Colonial and Indian collections for educational purposes.

A central stand for publications and an enquiry office have been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Handbooks, pamphlets, circulars, etc., containing information relating to the commerce, agriculture, mining and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. Lists of the publications available for distribution or sale are provided, and the principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the departments in the main buildings.

The Scientific and Technical Department.—The research laboratories and workrooms of this department were established in order to provide for the investigation of new or little-known natural products from the Colonies and India and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade and industries of the Colonies and India.

The work of this department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have been also made by the Foreign Office, whereby British representatives abroad may transmit to the department for investigation such natural products of the countries to which they are appointed as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the department and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

A reference sample room is maintained in this department, in which are arranged samples of the principal materials which have been investigated and valued commercially during recent years, and as to which full information is available.

The Scientific and Technical Department works in co-operation with the Agricultural and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations and enquiries as are of a special scientific and technical character connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial value of products (animal, vegetable or mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which has been printed in a volume of Technical Reports and Scientific Papers, published in 1903. A series of selected reports is now being issued in the Miscellaneous Series of Colonial Reports. Of these selected reports, four parts have been published: Part I., "Fibres" [Cd. 4588]; Part II., "Gums and Resins" [Cd. 4971]; Part III., "Foodstuffs" [Cd. 5137]; Part IV., "Rubber and Gutta-Percha" [Cd. 6022]; whilst others are in preparation.

Mineral Surveys, under the supervision of the Director of the Imperial Institute, and conducted by surveyors selected by him, are in progress in several countries. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained.

Reports by the Director on the results of mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

African Tropical Service Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction on the subject of tropical cultivation and products in this course is given by members of the staff of the Imperial Institute.

Library and Reading Rooms.—The library and reading rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference and are regularly supplied with the

more important official publications and with many of the principal newspapers and periodicals of the United Kingdom, the Dominions, Colonies and India.

The library and reading rooms are on the first floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute and of other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownaggree corridor and rooms in connection with this Hall are in the occupation of the Indian section of the Imperial Institute. The hall is available for lectures, meetings, etc.

The "Bulletin of the Imperial Institute," is published quarterly by Mr. John Murray, 50a, Albemarle Street, London, price 2*s.* 6*d.*, post free, 2*s.* 9*d.* (annual subscription 11*s.*, including postage) and may be purchased through any bookseller, or from agents in the Colonies and India. The Bulletin contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (animal, vegetable and mineral).

The following societies have their headquarters at the Imperial Institute:—

International Association for Tropical Agriculture, British Section.—The object of this Association, the central bureau of which is in Paris, is the promotion of the scientific and practical study of all questions connected with tropical agriculture and the development and utilisation of natural resources, especially of tropical countries. The British section has its headquarters at the Imperial Institute. Members of the British section are permitted to use the library and reading rooms of the Imperial Institute and a writing room has been also provided for their use.

The Association proposes to hold an International Congress of Tropical Agriculture in London in 1914. The British Section will be responsible for the organisation of the Congress, which will be held at the same time as two International Exhibitions, viz., the Fourth International Rubber Exhibition and the First International Cotton, Fibres, Tropical Products and Allied Industries Exhibition.

British Women's Emigration Association.—The British Women's Emigration Association has been assigned offices on the mezzanine floor, which are open daily from 10 a.m. to 4 p.m. Advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge.

Colonial Nursing Association.—An office has been allotted on the mezzanine floor of the Imperial Institute to this Association, the principal object of which is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependencies.

LONDON:
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By DARLING & SON, Ltd., 34-40, Bacon Street, E.

1912.

Tropical Diseases Bureau.—Temporary office accommodation on the mezzanine floor has been provided for this bureau, the main purpose of which is to collect information regarding tropical diseases and to distribute it as widely as possible among those who are engaged in combating such diseases.

II.—GENERAL.

The present report relates to the work which has been carried out in the several Departments of the Imperial Institute during the year 1912, and is in continuation of previous reports (Report for 1906 and 1907, Cd. 3729-48; Report for 1908, Cd. 4448-10; Report for 1909, Cd. 4964-30; Report for 1910, Cd. 5467-23; Report for 1911, Cd. 6007-37).

In each of its Departments the work of the Imperial Institute shows continued progress.

The need for increased accommodation for the work of the Imperial Institute and for that of allied Societies, which is referred to in previous reports, is still severely felt. Some of the congestion in connection with storage room has been removed by the provision of a temporary building which has been erected in the West Quadrangle.

The North Gallery is now open throughout its length to the public, communication with the West Gallery having been greatly improved by the erection of a handsome bridge over the cartway from Prince Consort Road.

The whole of the exhibition space at present available is now allocated to the Collections of the Colonies and India, and only the small space in the Upper West Gallery remains for the purpose of temporary exhibitions. The laboratories and working-rooms of the Scientific and Technical Department now occupy not only the whole of the space available on the Second Floor, but in addition a portion of the First Floor and several rooms in the Basement. Further and more centralised accommodation is much needed, and this need will increase each year with the natural development of the work of the Department. In view of the large number of enquiries which are now being received on technical subjects at the Institute, a separate branch for dealing with enquiries and the collection of technical information is required.

The increased number of visitors to the Public Galleries and their increased use for educational purposes are a satisfactory recognition of the large amount of labour and thought which has been expended on their proper organisation. These Galleries still suffer from the want of conspicuous entrances from the front of the building, which often leads visitors to proceed by mistake to adjoining buildings.

An important change made during the year was the enlargement of the "Bulletin of the Imperial Institute" and the transfer of its publication to the firm of Mr. John Murray. This arrangement has allowed of the introduction of several new

features in the Bulletin, which is still edited by the Director and mainly prepared by the staff of the Scientific and Technical Department.

The more important features of the work in each Department of the Institute during 1912 are recorded in the following sections.

III.—STAFF.

During the year 1912 the principal members of the staff were as follows:—

Director of the Imperial Institute:—
Wyndham R. Dunstan, M.A., LL.D. F.R.S.

Director's Office.

Up to August, 1912:—
Secretary to the Director:—
Major E. J. Lugard, D.S.O.
Assistant Secretary to the Director:—J. J. K. Greenway, B.A (Cantab) (vacant from March, 1912).

From August, 1912:—
Assistant Secretaries to the Director:—
G. A. I. Bosanquet, B. A. (Cantab.).
The Hon. T. L. McClintock Bunbury, M.A. (Cantab.

Scientific and Technical Department.

Superintendent of Laboratories:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
Technical Superintendent:—
Harold Brown.
Assistant Superintendents:—
E. Goulding, D.Sc. (Lond.), F.C.S.
T. Crook, A.R.C.Sc., F.G.S.
Special Assistants:—
H. H. Robinson, M.A. (Oxon.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
B. E. Long, B.A. (Cantab.).
H. J. Jeffery, A.R.C.Sc., F.L.S.
Senior Assistants:—
A. E. Andrews, F.C.S.
S. J. Johnstone.
R. G. Pelly, F.I.C.
S. S. Pickles, D.Sc. (Vict.), F.C.S., (until April, 1912).
R. Gaunt, Ph.D. (Berlin), F.C.S.
J. R. Furlong, Ph.D. (Würzburg).
Assistants:—
W. O. R. Wynn.
G. M. Davies, B.Sc. (Lond.), F.G.S.
O. D. Roberts, A.I.C.
J. Shelton, A.I.C.
L. Wilson, B.Sc. (Lond.), (until April, 1912).
B. W. Whitfeild.
G. T. Bray.
H. W. Winter.

J. C. Earl, A.I.C.
L. E. Campbell, B.Sc. (Lond.), A.I.C.
G. L. Matthews, B.Sc. (Lond.).
J. Young.

The special officers of the Mineral Surveys of Ceylon, Southern Nigeria, Mozambique, and Gwalior (Central India), which are in progress under the supervision of the Director of the Imperial Institute, were:—

Ceylon:—
J. S. Coates, B.A. (Cantab.)
E. J. Wayland, F.G.S.

Southern Nigeria:—
A. D. Lumb, A.R.S.M., F.G.S.
M. Whitworth, A.R.S.M.

Mozambique Company's Territory:—
E. O. Thiele, M.Sc. (Melbourne), F.G.S.
R. C. Wilson, B.Sc. (Melbourne), F.G.S.

State of Gwalior, Central India:—
Douglas R. Home, F.G.S.
S. M. Owen, A.R.S.M., F.G.S.
E. J. Parsons, B.Sc., F.G.S.

EXHIBITION GALLERIES:—COLONIAL AND INDIAN COLLECTIONS.

Technical Superintendents:—
S. E. Chandler, D.Sc. (Lond.), F.L.S.
H. Spooner.
A. B. Jackson.

Assistant Technical Superintendent:—
F. W. Rolfe.

AFRICAN TROPICAL SERVICE COURSE.

Instructor in Tropical Cultivation:—
S. E. Chandler, D.Sc. (Lond.), F.L.S.

Instructors in Tropical Products:—
T. A. Henry, D.Sc. (Lond.), F.C.S.
Harold Brown.
E. Goulding, D.Sc. (Lond.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S.
R. G. Pelly, F.I.C.

The following members of the Staff resigned their appointments during 1912 to take up the positions indicated:—

Major E. J. Lugard, D.S.O., was appointed Political Secretary and Personal Assistant to the Governor and Commander-in-Chief of Nigeria.

Mr. J. J. K. Greenway, B.A. (Cantab.), was appointed Deputy-Governor of Wakefield Prison.

Dr. S. S. Pickles, D.Sc. (Vict.), left to take up an appointment as research chemist to a rubber manufacturing firm.

Mr. L. Wilson, B.Sc. (Lond.), resigned to take up an appointment with a firm of research chemists.

IV.—PUBLIC EXHIBITION GALLERIES.

The principal aim of the Colonial and Indian Collections in the Public Exhibition Galleries is to illustrate by means of exhibits, chiefly consisting of raw products and primary manufactures, the commercial and industrial resources of the various parts of the British Empire, and by these and other exhibits to present a view of their general position and resources.

By the provision of specially prepared descriptive labels for the exhibits much has been done to render them more attractive to visitors and to a large extent self-explanatory. Additional information is supplied when required by the Technical Superintendents, whose offices are adjacent to the galleries. Parties of visitors, including parties from schools, may, by arrangement, be accompanied through the galleries by the Superintendents, who explain the important features of the exhibits. The London County Council has shown special interest in the last-mentioned arrangement, and recognises its value in relation to the teaching of the commercial geography of the British Empire in schools in and near London.

A notable increase has taken place in the number of students from schools and other educational institutions who have visited the Exhibition Galleries. During the year 1912, 112 parties from schools, comprising 3,092 persons, attended, many of the parties being personally conducted by members of the staff.

A large part of the exhibits of agricultural produce in the Canadian Court were renewed during the year and decorative improvements made. That portion of the Canadian exhibits which was in the Upper West Gallery has been transferred to the North Gallery, thus rendering the Canadian Section continuous on one floor.

Progress was made with the arrangement of a new Court for Newfoundland, and also with the reorganisation of the Union of South Africa Court.

Rearrangement and improvements were made in the British Guiana and British Honduras Courts.

At the instance of the Ceylon Government and the Ceylon Planters' Association, a new pavilion has been erected as an extension of the Ceylon Court, and is in process of decoration and equipment.

Additional exhibits, comprising economic products, photographs, maps, etc., have been received for the Courts of the following Dominions, Colonies and Dependencies:—

India, Ceylon, Straits Settlements and Federated Malay States, Hong Kong, Cyprus, Union of South Africa, Mauritius, Seychelles, Nyasaland, British East Africa, Uganda, the Anglo-Egyptian Sudan, Gold Coast, Northern Nigeria, Southern Nigeria, Sierra Leone, Canada, British Guiana, Dominica, St. Kitts, Antigua, Falkland Islands, New Zealand, Fiji, Western Pacific, New South Wales, Papua.

Their Majesties the King and Queen have graciously lent a number of additional Royal presents, chiefly from India, which have been placed on exhibition in the galleries.

Several of the Crown Colonies have arranged to maintain at the Imperial Institute duplicate collections to illustrate their resources and industries. These collections are arranged by the staff of the Imperial Institute and lent to such temporary exhibitions in this country as these Colonies desire to participate in.

The Reference Collection in the Upper East Gallery of the principal standard commercial raw products of the world has proved of great interest to visitors, and has facilitated the comparison of new products received from the Colonies with those of established commercial and industrial value.

Additions and renewals have been made to the comprehensive collection of samples of British-grown cotton which is shown in the Public Galleries.

Specimens of Colonial and Indian products have been presented to a number of schools to assist in the formation of school museums and in the teaching of the commercial geography of the British Empire.

An exhibit to illustrate the rubber resources of the British Empire, comprising specimens of the principal rubber-yielding plants and representative samples of rubber from all the British Colonies and Dependencies where rubber is produced, was lent from the Imperial Institute for the third International Rubber Exhibition which was held in New York at the end of September, 1912.

The number of ordinary visitors to the Exhibition Galleries during 1912 was 205,503.

The number of publications relating to the Dominions, Colonies and India distributed to enquirers at the Central Stand in 1912 was 17,595.

V.—THE LIBRARY.

The additions to the library during the year 1912 numbered 2,067 volumes and pamphlets, whilst the number of newspapers and periodicals received was 27,520.

Besides its constant use by members of the staff, the library has been used by Life Fellows of the Imperial Institute, and also by enquirers for special information, the number of whom in 1912 was 810. The facilities afforded by the library have been utilised during the year by a number of officers of the Colonies and Protectorates and of India at home on leave, who have also been given assistance in pursuing special enquiries.

VI.—"BULLETIN OF THE IMPERIAL INSTITUTE" AND OTHER PUBLICATIONS.

"*Bulletin of the Imperial Institute.*"

In the year 1912 the Bulletin was enlarged to about twice its former size, and several new features were introduced. Among these may be mentioned special articles on agricultural and other subjects by well-known authorities, and a summary of current

information on tropical agriculture and the development of natural resources throughout the world. The publication was transferred to the firm of Mr. John Murray, Albemarle Street, London.

The following are the titles of the articles which have appeared in the quarterly numbers of the "Bulletin of the Imperial Institute," Vol. X., 1912:—

Reports of Investigations conducted at the Imperial Institute:—

Rubber Resources of Uganda.
A Saccharine Constituent of Para Rubber.
Aromatic Grass Oils, Part III.
Kola Nuts from British West Africa.
Coca Leaves from Ceylon and Federated Malay States.
Economic Products from Mauritius.
Sumach from Cyprus.
Timbers from Uganda.
Hibiscus Fibres from the Northern Territories, Gold Coast.
Some Cotton Soils of the Nyasaland and Uganda Protectorates.
Diatomite from the East Africa Protectorate.
Tobacco Industry of Ceylon.
New Gutta-yielding plants from the Gold Coast.
Ficus elastica Rubber from Southern Nigeria.
"Balata" Rubber (*Ficus Vogelii*) from Northern Nigeria.
The Rubber of *Cryptostegia grandiflora*.
Silk from India.
Cotton and Sisal Hemp from Papua (British New Guinea).
Fibres from India.
Utilisation of *Caesalpinia digyna*.
Oil-seeds of *Telfairia pedata*.
Lophira Oil-seeds from West Africa.
Oils and Oil-seeds from Hong Kong.
Tea-seed Oil and Tea-seed Cake.
Edible Beans from Hong Kong.
West African Cocoa.
The Improvement of Cotton in India.
Experiments with New Materials for the Manufacture of Paper.
Fibre of *Vigna sinensis* from Northern Nigeria.
Rubber from Ceylon.
Funtumia Rubber from the Gold Coast.
Chimeya Rubber from North-Western Rhodesia.
Rubber from Papua.
Rubber of *Hevea confusa* from British Guiana.
Maize from the Sudan.
Beans from Southern Nigeria.
Tea from Southern Nigeria.
Coffee from the Uganda and East Africa Protectorates.
Minerals from the Falkland Islands.
Soils from the East Africa Protectorate.
The Cotton Industry of Nyasaland.
Wild Plantain Fibre from India.
Silk from Ceylon.

Wool from Cyprus.
Turpentine Oils from India.
Lemon Grass Oils from India.
Fruits and Oil of Balanites Sp. from Portuguese East Africa.
"Katiau" Seeds and Fat from British North Borneo.
Ceara Rubber.
Landolphia Kirkii Rubber from Natal.
Para Rubber from Dominica.
Cocoa from the Gold Coast.
Wheat from the East Africa Protectorate.
Tapioca (Cassava) Flour and Starch.
Bermuda Arrowroot.
Arrowroot from the Gold Coast.
Musa Seeds from the East Africa Protectorate.
Cayenne Pods from Rhodesia and the Gold Coast.
Cloves from Zanzibar and the Straits Settlements.
Leather and Gall-Nuts from Hong Kong.
Crude Petroleum from the Gold Coast.

Special Articles:—

Recent Agricultural Developments in Uganda. By P. H. Lamb, lately Chief Agricultural Officer in Uganda.
The Cotton Worm in Egypt. By Gerald C. Dudgeon, F.E.S., Director-General of the Department of Agriculture in Egypt.

General Notices respecting Economic Products and their Development:—

The Coconut and its Commercial Uses.
Cultivation, Preparation and Utilisation of Hemp and Hemp Seed (*Cannabis sativa*).
Cultivation and Preparation of Ginger.
Agricultural Work in Seychelles.
The Cultivation of Cigar Tobacco, with special reference to Java.
Shea Nuts and Shea Butter.
Rubber-tapping Experiments in Southern Nigeria.
Economic Developments in the Belgian Congo.
The Coal Resources of the British Crown Colonies and Protectorates.
Robusta Coffee.
Forestry Developments in Southern Nigeria.
Notes on Planting and other Industries in India and Ceylon.
Occurrence, Distribution, and Utilisation of Bismuth Ores.
The Occurrence of Iron Ore in Trinidad.
The Production of Valonea.
Phaseolus lunatus Beans.

General Notes:—

Candelilla Wax.
Florida Beans from Nyasaland.
New Zealand Hemp.
Sisal Hemp in Quilimane.
Forestry in Norway.

Douglas Fir (*Pseudotsuga taxifolia*).
Aspens.
The Colouring Matter of Ebony.
Agricultural Treatment of Sandy Districts.
Iron Ore from Trinidad.
Magnesite from Cyprus.
Copper-mercury Ore from Queensland.
Native Labour Regulations in Mozambique.
Imperial Institute Handbooks on Tropical Resources.
West Indian Satinwood.
Oil of "Nepal Camphor Wood."
Citronella Grass.
***Mesembryanthemum Mahoni* Roots from the Transvaal.**
Rubber Exhibition in Java.
Cultivation of Fibres in Java.
"Root-cotton."
Perilla Seed and Oil.
Ash of *Salvadora persica*.
Molybdenite in Canada.
Asbestos from Cyprus.
The Wattle-bark Industry of the East Africa Protectorate.
Work of the British Cotton Growing Association.
Cotton from Uganda.
Samarskite in India.
Mining in the Federated Malay States.
Magnesite from Southern Rhodesia.
Work of the Ceylon Agricultural Society.
Cotton from Ceylon.
Cotton Growing in French Colonies.
Match Industry in India.
Mining in India.
Mining in the Gold Coast.
Aluminium Nitride.

Recent Progress in Agriculture and the Development of Natural Resources:—

General Agriculture, Foodstuffs and Fodders, Essential Oils, Oils and Oil-seeds, Rubber, Fibres (including Cotton), Tobacco, Forestry and Forest Products, Economic Minerals, &c.

Notices of Recent Literature:—

New books.

Other Publications.

During 1912 the following publications relating to the work of the Imperial Institute have been issued:—

Annual Report on the Work of the Imperial Institute, 1911 (Colonial Reports, Annual [Cd. 6007-37]).

Report on the Results of the Mineral Survey of Southern Nigeria, 1910 (Colonial Reports, Miscellaneous No. 83 [Cd. 6425] of 1912).

Selected Reports from the Scientific and Technical Department, Pt. IV., Rubber and Gutta-percha (Colonial Reports, Miscellaneous No. 82 [Cd. 6022] of 1912).

Imperial Institute Handbooks to the Commercial Resources of the Tropics, with special reference to British West Africa.—The second volume of this series, which is issued under the authority of the Secretary of State for the Colonies and edited by Professor Dunstan, was published in April 1912 by Mr. John Murray, and is entitled "Cocoa: its Cultivation and Preparation," By W. H. Johnson, F.L.S., Director of Agriculture in Southern Nigeria. The third volume, dealing with rubber, was in preparation at the end of the year.

The following is a list of scientific and technical contributions made during the year by members of the Staff to unofficial publications:—

"The Scientific and Technical Department of the Imperial Institute." By Dr. T. A. Henry. (Chemical World, 1912, Vol. 1, p. 227.)

"The Vegetable Alkaloids." By Dr. T. A. Henry. (Allen's Organic Analysis, 4th edition, Vol. 6, p. 167.)

"La Combustibilité de Tabac." By Dr. T. A. Henry and Dr. S. J. M. Auld. (L'Agronomie Tropicale, 1912, Vol. 4, pp. 60, 65.)

"Balata." By H. Brown. (Thorpe's Dictionary of Applied Chemistry, 1912, Vol. 1, p. 413.)

"Guttapercha." By H. Brown. (Thorpe's Dictionary of Applied Chemistry, 1912, Vol. 3, p. 25.)

"Cotton." By Dr. E. Goulding. (Thorpe's Dictionary of Applied Chemistry, 1912, Vol. 2, p. 153.)

"On the Frequent Occurrence of Ankerite in Coal." By T. Crook. (Mineralogical Magazine, 1912, Vol. 16, p. 219.)

"On Strüverite from the Federated Malay States." By T. Crook and S. J. Johnstone. (Mineralogical Magazine, 1912, Vol. 16, p. 224.)

"Extraction Apparatus." By H. H. Robinson. (Thorpe's Dictionary of Applied Chemistry, 1912, Vol. 2, p. 475.)

"The Geometry of Twin Crystals." By Dr. J. W. Evans. (Proceedings of the Royal Society of Edinburgh, 1912. Vol. 32, Part 4, p. 416.)

'The Constituents of West Indian Satinwood." By Dr. S. J. M. Auld and Dr. S. S. Pickles. (Transactions of the Chemical Society, 1912, Vol. 101, p. 1052.)

"The Essential Oil of 'Nepal Sassafras'." By Dr. S. S. Pickles. (Transactions of the Chemical Society, 1912, Vol. 101, p. 1433.)

"The Composition of Bassia Fats." By R. G. Pelly. (Journal of the Society of Chemical Industry, 1912, Vol. 31, p. 98.)

"The Mineral Composition of the Arctic Bed at Ponder's End." By G. M. Davies. (Quarterly Journal of the Geological Society, 1912, Vol. 68, p. 243.)

VII.—SCIENTIFIC AND TECHNICAL DEPARTMENT.

An account is given in the succeeding pages of the work carried on in this Department during the year, partly in conducting scientific, technical and commercial investigations as to the composition and value of raw materials—animal, vegetable and mineral—and partly in supplying information respecting the value and utilisation of such materials, and their cultivation or production. The number of reports completed in 1912 was 475, and at the end of the year 150 investigations were in progress. Details respecting these investigations are given under the heading of the subject to which they relate. The countries for which investigations have been conducted are:—Antigua, Commonwealth of Australia, Bahamas, Barbados, Bermuda, British Guiana, British Honduras, British North Borneo, Canada, Ceylon, Cyprus, Dominica, East Africa Protectorate, Falkland Islands, Federated Malay States, Fiji Islands, Gambia, Gold Coast, Hong Kong, India, Jamaica, Labuan, Malta, Mauritius, Montserrat, New Zealand, Northern Nigeria, Nyasaland, Papua, Rhodesia, St. Vincent, Sierra Leone, Solomon Islands, Somaliland, Southern Nigeria, Straits Settlements, Sudan, Trinidad and Tobago, Turks and Caicos Islands, Uganda, Union of South Africa, Zanzibar. A large number of enquiries from commercial firms in the United Kingdom were also dealt with, which involved the collection of a very considerable amount of special information. The work of collecting and collating this information, for which there is an increasing demand on the part of British manufacturers and merchants, is severely taxing the ordinary staff of investigators attached to the Department, and has now attained dimensions which require that this work should be dealt with by a separate staff.

Minerals.

Countries of Origin:—Cyprus, Sudan, Somaliland, East Africa Protectorate, Uganda, Nyasaland, Rhodesia, Union of South Africa, Gambia, Northern Nigeria, Southern Nigeria, India, Ceylon, Federated Malay States, Commonwealth of Australia, Canada, West Indies, Falkland Islands, United Kingdom, Foreign Countries.

Mineral Surveys.

Mineral Surveys were conducted during the year in Southern Nigeria, Ceylon, and in the Territory of the Mozambique Company, Portuguese East Africa, and considerable progress was made in the examination at the Imperial Institute of the mineral specimens collected in these countries. A Mineral Survey was also organised in the State of Gwalior, Central India.

Southern Nigeria.—A summary of the field work carried out by the Officers of the Survey during 1910, together with the results of examination at the Imperial Institute of the specimens collected, was published in the Miscellaneous Series of Colonial Reports, No. 83 [Cd. 6425], 1912.

The chief work of the Survey was the further investigation of the lignite and coal deposits of the country. Borings were made in the Okpanam district and the main seam of lignite, from which

samples had previously been sent to the Imperial Institute, was shown to vary in thickness from 17 feet 10 inches to 23 feet. Four samples from these borings were examined at the Imperial Institute and the results indicated that the lignite is of good and uniform quality in this area. In the Obompa (Obongkpa) district, in addition to a 20-foot seam, previously discovered, five other seams were located in the Iyiawku stream. These six seams have an aggregate thickness of 70 feet in a total thickness of 250 feet of strata. Of three samples sent for examination from this area, two contained a large amount of earthy matter, but the third was lignite of good quality.

Numerous main streams and their tributaries were examined to the north, south and east of Udi, and at many places extensions of a seam of sub-bituminous coal occurring in the Ofam River were met with. A workable seam of good coal varying in thickness from 4 feet 10 inches to 5 feet 8 inches and extending over a considerable strip of country, as well as smaller seams, was located in the Nike district. From an examination of the eastern border of the hill country, from a line north-west of Nike to north-east of Orukuram, it seems probable that surface outcrops of coal do not exist in this area. The presence of Upper Cretaceous rocks, however, indicates that coal beds may occur at a deeper level, but boring would be necessary to prove their occurrence. Eleven samples of sub-bituminous coal from the Udi district were examined and found to be similar to previous samples from this locality, indicating that the coal maintains a uniform character in the district.

Eight concentrates were examined, the only noteworthy feature of which was the presence of monazite, but in no case was the amount considerable.

Five clays suitable for local use for pottery making were examined, as well as two oil-shales which yielded only small quantities of oil on distillation.

Specimens accompanying the Interim Reports on the field work of the Survey during 1911 and 1912 were under examination at the close of the year.

Ceylon.—Reference was made in the previous Annual Report to the arrangements made for carrying out prospecting work in Ceylon on a larger scale than had been possible previously to the Survey. These arrangements were further developed in 1912 by the purchase of a steam-drill, which was brought into use in the course of the year. The material reported on during the year comprised various concentrates, including some from bore-holes in the gem gravels of Getahetta Valley, miscellaneous minerals, *e.g.*, micas, ilmenite, magnetite, etc., and a hydrated iron ore of promising quality. At the close of the year samples of iron ore and garnets and a small specimen of platinum were under examination, whilst a report on various thorium-bearing minerals collected by the Survey was in preparation.

Mozambique.—A summary of the field work carried out by the Mineral Surveyors in the Mozambique Company's Territory, Portuguese East Africa, during 1911 and the results of examination of the specimens forwarded to the Imperial Institute during

that year, were supplied to the Mozambique Company. This was the first season's work of the Survey, and the results, though necessarily of a somewhat preliminary character, were distinctly encouraging. Coal was located in the Territory, and although the sample examined at the Imperial Institute was of poor quality, from a prospecting standpoint the occurrence is of undoubted importance. Alluvial gold was found to be very widely distributed, and although the deposits so far examined are not very promising as dredging propositions, the prospects obtained in certain localities were sufficiently good to warrant further exploration for reefs. A bed of almost pure crystalline limestone was found to the south of the Lucite, which may be of importance for local use as a source of lime for agricultural purposes or for making mortar for building. An occurrence of graphite was located at M'Punga, and monazite and tinstone were found in small quantities in concentrates.

At the close of the year mineral specimens from Mozambique forwarded with the first Interim Report of 1912 were under examination.

Gwalior State.—The arrangements for the conduct of a Survey in this native Indian State were completed during the year and the following Surveyors were appointed to carry out the field work:—Douglas R. Home, F.G.S.; S. M. Owen, A.R.S.M., F.G.S.; E. J. Parsons, B.Sc., F.G.S. They reached Gwalior towards the end of 1912.

General.

Cyprus.—Specimens of iron pyrites and magnetic iron ore were examined, and information was furnished regarding the possibility of finding a market for the green pigment known as "terre verte."

Somaliland.—Samples of bitumen were found to be of very promising character and larger samples were requested for more detailed examination. These latter were under investigation at the close of the year.

East Africa Protectorate.—Several samples of mica were reported on. Although apparently taken from a weathered outcrop, and consequently of poor quality, some of the plates were of considerable size and it was recommended that the occurrence should be further investigated.

Uganda.—A memorandum on the utilisation of a deposit of asphalt at Kibiro was furnished to the Government of Uganda and a sample of the material was reported on. A sample of "crude soda" contained 16·02 per cent. of matter soluble in water, consisting chiefly of sodium carbonate and bicarbonate. It would be of little or no value except as a source of "soda" for small local requirements.

Nyasaland.—Specimens of graphitic schist, pyrite and pyrrhotite were reported on and information regarding the market for molybdenite was supplied.

Union of South Africa.—A sample of powdered talc proved to be of rather poor colour and of moderate quality and was valued at about 42*s.* to 45*s.* per cwt. Information was also supplied to the Government of the Union as to the market value and sources

of supply of talc in the United Kingdom. Other minerals examined included a greenstone of considerable decorative value from the Transvaal and a sample consisting of a mixture of minerals from the same Province, of which kyanite, a possible gemstone, was the most important.

British West Africa.—Fifteen samples of clay and three samples of sand and gravel from Gambia were examined. The former would only be of local use for brickmaking and coarse pottery, whilst an ironstone gravel, although of no value for export, might be employed locally by natives as an iron ore.

Five samples of monazite and tinstone-monazite concentrates from Northern Nigeria were reported on. One of these, consisting almost wholly of monazite, contained 6·90 per cent. of thoria and would be saleable for the manufacture of thorium nitrate.

In addition to the examination of specimens collected by the Mineral Survey of Southern Nigeria (*see* p. 17), a number of other minerals from this country were reported on. These included 50 specimens of borings from wells sunk in the course of a search for petroleum, a sample of tin ore consisting of almost pure tinstone and containing not more than 4 or 5 per cent. of impurity, and a sample of fairly pure calcium phosphate. The latter would be of value as a source of phosphatic manure but would only be worth about £1 2*s.* 6*d.* per ton in the United Kingdom. The samples from Southern Nigeria, other than those collected by the Survey, under investigation at the close of the year consisted of sixteen specimens of borings from wells and six samples of silver-lead ores.

India.—A sample of galena from Gwalior contained 96·46 per cent. of lead sulphide, equivalent to 83·45 per cent. of metallic lead, together with about 1 oz. of silver to the ton, and was worth about £10 10*s.* per ton, c.i.f. Swansea (May, 1912). A sample of mica from the same State consisted of muscovite mica of promising quality, and further samples were asked for so that an estimate of the value of the material obtainable from the deposit might be arrived at. The other minerals examined included two samples of China clay, a series of seven samples of clays, bauxites and sandstones, two samples of red ochre and one of yellow ochre, and an impure dolomitic limestone.

Federated Malay States.—A sample of cerussite concentrate consisted chiefly of ferruginous cerussite together with tinstone and other minerals. It was found to contain 41·57 per cent. of lead, 10·99 per cent. of tin, and 2·819 oz. of silver per ton. The technical examination and smelting trials of the concentrate were in progress at the close of the year. A sample of sub-bituminous coal from the recently discovered seams at Rantau Panjang was reported on. It contained 18·23 per cent. of water and had a calorific value of 5,466 calories. A sample of oil shale was also reported on.

Commonwealth of Australia.—A sample of crude white kaolin from Tasmania yielded on washing about 50 per cent. of fine kaolin of good quality and suitable for use in the manufacture of pottery or porcelain. Information relating to the marketing of a number of Australian metals and minerals, *e.g.*, mercury,

mica, osmiridium, scheelite and gadolinite, was supplied. Four samples of limestone and one sample of shale from Tasmania were under examination at the close of the year.

West Indies.—A sample of salt from Turks and Caicos Islands was received for examination towards the end of the year.

Falkland Islands.—A sample of peat ash was being investigated at the close of the year.

United Kingdom.—A number of samples of minerals were received from merchants and others for identification or valuation, and numerous enquiries were dealt with relating to the utilisation and occurrence of various minerals in the Colonies and India.

Foreign Countries.—In addition to the specimens of minerals collected by the officers of the Mineral Survey in Mozambique (*see* p. 18) a large number of minerals received from the British Vice-Consul at Broussa, Turkey, and six samples of "nitrate" shales from Egypt were reported on. The percentage of sodium nitrate in the latter ranged from 4·85 to 15·43. In the case of the richest shale it was possible to extract 80 per cent. of the nitrate by percolating 100 parts of the shale with 80 parts of water, the dried product having the following percentage composition:—Sodium nitrate 50·6, sodium chloride 38·6, sodium sulphate 10·8. Such material would probably be rich enough to transport to a district where plenty of water is available and where it could be purified by recrystallisation.

A sample of "sulphur" earth from Jaffa was received for examination towards the close of the year.

Soils.

Countries of origin:—East Africa Protectorate, Uganda, Nyasaland, Northern Nigeria, Foreign Countries.

Three samples of soils from the East Africa Protectorate were reported on, as well as six samples of a so-called "guano," which consisted of mud and sand impregnated with "soda."

A sandy soil from near Zomba, Nyasaland, was deficient in "total" and "available" phosphoric acid, and would benefit by the addition of superphosphate or bone meal.

Twelve samples from Mozambique consisting of surface soils and subsoils from six localities were examined. In two cases the subsoil was richer in plant food than the surface soil and in a number of cases the soil was deficient in nitrogen, "available" phosphoric acid, and potash. One of the soils contained over 60 per cent. of calcium carbonate and would consequenty be unsuitable for some crops but it could be used for dressing soils deficient in lime.

At the end of the year six soils from Uganda and 31 from Nyasaland were under examination.

Fibres (including Cotton).

Countries of Origin:—Malta, Cyprus, Sudan, East Africa Protectorate, Uganda, Nyasaland, Rhodesia, Union of South Africa, Gold Coast, Northern Nigeria, Southern Nigeria, Mauritius, India, Ceylon, Commonwealth of Australia, Papua, New Zealand, West Indies, British Guiana, United Kingdom, Foreign Countries.

Cotton.

Sudan.—Seventeen samples of ginned cotton and one of seed-cotton were reported on. Small consignments of ten of the ginned cottons were subsequently sold in Liverpool. Two samples of Mitafifi cotton were of good quality and were valued at 9¼*d.* to 9½*d.* and 10*d.* to 10¼*d.* per lb. respectively with "fully good fair" Mitafifi at 9$\frac{15}{16}$*d.* per lb. The sample of seed-cotton was obtained from wild plants and appeared to be of Mitafifi origin; ginned cotton prepared from this was valued at only ½*d.* per lb. less than "fully good fair" brown Egyptian, which was quoted at 9*d.* per lb. on the same date. Another sample of Egyptian cotton also proved to be similar to Mitafifi cotton, and was valued at the current price of "fully good fair" brown Egyptian. A sample of Nubari cotton was of excellent quality and was valued at 11*d.* per lb. with "fully good fair" Nubari at 10⅞*d.* per lb. A second sample of Nubari cotton was valued at 10½*d.* per lb. with "good" Nubari at 10¾*d.* per lb. A sample of Abassi cotton was also of excellent quality and was valued at 12*d.* per lb. with "fully good fair" Abassi at 12⅜*d.* per lb. A sample of Voltos cotton was valued at 11*d.* to 11¼*d.* per lb. with standard Voltos at 12*d.* per lb., and a sample of Sakellaridis cotton was regarded as worth 11¼*d.* to 11½*d.* per lb. with best Sakellaridis at 12*d.* A sample of a variety of cotton described as "Makhsous" (choice) proved to be of excellent strength and as fine as Sea Island cotton; it was valued at 10½*d.* per lb. (January, 1912).

Six samples of Improved American Upland cottons were of good quality on the whole, but most of them were somewhat irregular in length of staple; they were valued at from 7·00*d.* to 9·00*d.* per lb., with "middling" American at 7·11*d.* per lb. Another sample of American cotton was valued at 5·25*d.* per lb., with "middling" American at 5·05*d.*

East Africa Protectorate.—Three samples of Egyptian cotton were examined. They were all of fair quality and were valued as follows:—Abassi cotton, 10½*d.* per lb., with "good" Abassi at 11¼*d.* per lb.; Yannovitch cotton, 9¾*d.* to 10*d.* per lb., with "good" Yannovitch at 12½*d.* per lb.; Mitafifi cotton, 8¾*d.* per lb., with "fully good fair" brown Egyptian at 10$\frac{7}{16}$*d.* per lb. A sample of Caravonica cotton was valued at 7*d.* per lb, with "moderately rough" Peruvian at 8·25*d.* per lb.

Uganda.—Three samples of Improved American Upland cottons and one of Egyptian cotton were reported on. A sample of Sunflower cotton grown from seed produced in the East Africa Protectorate was valued at 8*d.* to 8¼*d.* per lb., with "fully good fair" Abassi at 10⅜*d.* and "middling" American at 5·93*d.* per lb.; a sample of the same variety grown from seed sent to Uganda by the British Cotton Growing Association was valued at 7½*d.* per lb.; and a sample of Allen's Improved cotton was of excellent quality and was valued at 9¼*d.* to 9½*d.* per lb. A sample of Abassi cotton was rather short in staple and was valued at 9½*d.* per lb..

Nyasaland.—A series of eighteen samples of Nyasaland Upland cottons obtained from selected acclimatised plants was examined. The lint from the various samples was very similar in general

appearance and exhibited very little difference in length. The samples could be divided into three classes according to strength, which was found to be considerably improved as compared with similar cottons from Nyasaland examined at the Imperial Institute in previous years. A sample of the Nyasaland Upland cotton which won the first prize at the Blantyre Show and the British Cotton Growing Association Cup in 1911 was also examined. It was of excellent quality on the whole and rather stronger than, but not so long as, the best grown Nyasaland cotton of 1910. Four samples of Griffin cotton from specially selected plants were indistinguishable in general appearance and on the whole were of good quality, their chief defect being their irregular strength. A sample of Nubari cotton was valued at 9*d.* to 9½*d.* per lb., with "middling" American at 5*d.* and "fully good fair" Nubari at 10½*d.* per lb. A sample of Mitafifi cotton was of uneven colour and was valued nominally at 8*d.* per lb., with "middling" American at 5*d.* and "fully good fair" brown Egyptian at 9½*d.* per lb. A sample of Abassi cotton was valued at 10*d.* per lb., with "fully good fair" Abassi at 11*d.* per lb. A sample of Brazilian cotton was also examined.

Four samples of Nyasaland Upland cotton were under examination at the close of the year.

Rhodesia.—Two samples of Abassi cotton were valued at 8½*d.* to 8¾*d.* per lb. and 8½*d.* per lb. respectively, with "good fair" Abassi at 9½*d.* per lb. A sample of rather short Nyasaland Upland cotton and one of Allen's Improved cotton were both rather weak and were valued at 7½*d.* per lb., with "middling" American at 6·63*d.*, and "good fair" Abassi at 9½*d.* per lb.

Union of South Africa.—Two samples of Caravonica cotton from Natal were reported on. Both were rather weak, one being uneven in colour and stained and the other of irregular length. The former was valued at 7½*d.* per lb. and the latter at 9*d.* per lb., with "good moderately rough" Peruvian at 9½*d.*, "fully good fair" Upper Egyptian at 10⅛*d.*, and "middling" American at 6·63*d.* per lb.

Twenty-two samples of cotton from the Transvaal, five from Cape Province and one from Natal were examined and added to the Reference Collection of commercial cotton samples at the Imperial Institute.

British West Africa.—A series of thirteen samples of seed-cotton and lint from the Gold Coast were reported on. Samples of Nyasaland Upland cotton were valued at 6½*d.* to 7*d.* per lb.; several Improved American cottons were valued at 5*d.* to 5¼*d.* per lb., whilst two indigenous varieties of good quality and well worth cultivating, were valued at 5*d.* to 5½*d.* per lb., with "middling" American at 5*d.* per lb.

Several samples of an indigenous cotton known as "Matankanawa" from Northern Nigeria were examined and reported on. The cotton proved to be of good, useful character and was valued nominally at about the same price as, or slightly above, that of "middling" American. The plant was identified from its leaves as *Gossypium arboreum*, Linn., but in the absence of flowers the variety could not be definitely determined although it

was possibly var. *sanguineum*, Watt. A sample of indigenous tree cotton from Egga, Northern Nigeria, resembled "Matankanawa" cotton in general appearance, but was not quite so long and decidedly coarser. A cotton plant from Northern Nigeria, which had apparently been attacked by boll-worm, was received for examination and suitable remedial measures for dealing with this pest were recommended.

India.—Ten samples of Indian cottons grown at the Agricultural Experiment Farm, Akola, Central Provinces, were reported on. They were of high grade for this class of cotton and were valued at 5¾*d.* to 6¼*d.* per lb., with "fine" Broach at 5¾*d.* and "middling" American at 6*d.* per lb.

One hundred and eleven samples of Indian cottons were examined and added to the Reference Collection, and fifty-two samples of ginned and unginned cottons from Bellary, Madras, were under examination towards the close of the year.

Ceylon.—A sample of Black Rattler cotton was valued at 8½*d.* per lb., with "middling" American at 6·57*d.* and "good" Abassi at 11*d.* per lb.

Commonwealth of Australia.—A sample of "Durango" cotton from Western Australia was valued at 9*d.* per lb., with "middling" American at 6·37*d.* per lb., and "good" Abassi at 11*d.* per lb. A sample of Sea Island cotton from the same State proved to be coarser than ordinary Sea Island cotton, but was of good colour and length and was valued at 13*d.* per lb., with "choice" Georgia at 12½*d.* per lb.

A sample of seed-cotton from Queensland yielded a rather coarse, harsh, weak lint, which was classed as "barely good middling" and valued at 6·80*d.* to 6·90*d.* per lb., with "middling" American at 6·46*d.* per lb. Two samples of Egyptian cottons from Queensland were under examination at the close of the year.

Papua.—A sample of Caravonica cotton was of excellent quality and longer than any sample of this variety previously examined at the Imperial Institute. It was somewhat rough and woolly and suitable for admixture with wool for "union" yarns, and was valued at 10*d.* per lb., with "good moderately rough" Peruvian at 8·25*d.*, and "good rough" Peruvian at 9*d.* per lb.

West Indies.—A sample of cotton from Trinidad obtained by crossing a native variety with Sea Island cotton proved to be equal or slightly superior to "fancy" Florida Sea Island cotton.

A sample of Sakellaridis cotton was of excellent quality and was valued at 12½*d.* per lb., with "fine" Yannovitch at the same price.

Thirty samples of cotton from Montserrat, twenty-three samples from St. Vincent, and seventeen from Antigua were examined and added to the Reference Collection.

British Guiana.—A sample of indigenous Sea Island cotton was valued at 14*d.* per lb., with "fancy" Florida Sea Island at the same price, and another sample, shorter and less soft than ordinary Sea Island cotton, was valued at 8*d.* per lb., with "middling" American at 6·63*d.* and "good" Abassi at 11½*d.* per lb. Seven samples of indigenous cottons were valued at prices ranging from

7*d*. to 10*d*. per lb. on the same date. Two other samples of indigenous cottons were valued at 8*d*. and 10½*d*. to 11*d*. per lb. respectively, with "middling" American at 6·57*d*. and "good" Abassi at 11*d*. per lb.

Jute and Similar Fibres.

British West Africa.—A fibre, resembling Hibiscus fibre, from Southern Nigeria was valued nominally at £19 to £21 per ton with China jute at £17 to £19 per ton, but some difficulty would probably be found in selling such fibre, on account of its possessing certain characters which render it unsuitable for spinning with jute.

India.—Four samples of jute were examined with a view to ascertaining the relations between their tensile strength, percentage of cellulose and behaviour on treatment with hydrolytic agents. It was found that the strongest samples were those containing the greatest percentage of cellulose and in which the loss incurred on boiling with dilute alkali was lowest.

A sample of Sida fibre from Bengal consisted of fine, silky, lustrous fibre comparable with the finest Calcutta jute and was valued at about £30 per ton with "first native marks" Calcutta jute at £20 per ton. A small consignment of this fibre was subsequently sold at the rate of £27 per ton. There appears to be a ready market for fibre of this quality in the United Kingdom and larger consignments should realise the higher price mentioned.

Samples of *Malachra capitata* and *Urena lobata* fibres were under examination at the end of the year.

Fibres suitable for Cordage Manufacture.

Cyprus.—Samples of *Agave americana*, *A. rigida* var. *sisalana*, *Furcraea gigantea* and "aloe" fibres were reported on. They were all rather weak and brittle and too short to be of good commercial value. The Furcraea fibre was valued nominally at £16 to £18 per ton, and the other fibres at £14 to £15 per ton with best Mexican Sisal hemp at £25 per ton.

Sudan.—A sample of "Ushar" fibre obtained from the stems of *Calotropis procera* was found to be of fair strength and of good length and to be suitable for the manufacture of rope. It was valued at £24 per ton, with Mexican Sisal hemp at the same price. A memorandum dealing with the extraction and preparation of this fibre was supplied to the Government of the Sudan. Samples of "Ushar" fibre rope and "Marakh" fibre and rope were also examined.

British West Africa.—A sample of the fibre of *Polygala butyracea* ("Cheyi" fibre) was regarded by commercial experts as a soft "roping" hemp, similar to Bombay hemp, and of equal value to the "fine" grade of this fibre, which was then quoted at £26 to £27 per ton.

Botanical specimens of the plant which yields "Binni" fibre (*see* Report on the Work of the Imperial Institute for 1911 [Cd. 6007-37], p. 27) were received from Northern Nigeria and identified at the Royal Botanic Gardens, Kew, as *Vigna sinensis*, Endl. Specimens of this plant were also received from Northern

Nigeria under the name of "Yawa." An examination of the latter indicated that the leafy stems would probably be unsuitable for the extraction of fibre owing to the presence of numerous nodes, but that the strong bast fibre contained in the fruiting stems might possibly serve as a hemp substitute.

India.—Three samples of Sisal hemp were of very good quality and were valued at £25, £23, and £22 per ton respectively, with best Mexican Sisal at £22, and the best grades of East African Sisal at £24 to £26 per ton. A sample of Sisal tow consisted of fine, strong, tangled fibre and was valued at £13 to £14 per ton. A sample of clean, well-prepared wild plantain fibre from Burma was regarded as specially valuable owing to its softness, and was valued nominally at about £20 per ton, with "fair current" Manila hemp at £22 to £22 10*s.* per ton.

Papua.—A sample of Sisal hemp was of good quality and was valued at £25 per ton, with best Mexican Sisal at £26 per ton. A sample of "Kebiri" fibre was too short to be of much commercial value, being classed as tow and valued at only £10 to £12 per ton, but if produced in large quantities and not less than 3 feet in length it should be saleable readily at about £25 to £30 per ton.

New Zealand.—A sample of fairly well prepared "Cabbage tree" fibre was of irregular strength, and only 1 ft. 5 in. to 2 ft. 10 in. long. If 3 to 4 ft. in length it would be worth £25 per ton, with Mexican Sisal at £34 per ton. A sample of New Zealand hemp extracted by a special process was not well prepared and was valued at £22 to £23 per ton with "fair" New Zealand hemp at £30 per ton.

West Indies.—A sample of *Agave americana* fibre from Antigua exhibited remarkable elasticity, elongating 30 to 40 per cent. of its original length before breaking and for this reason commercial experts stated that it would be of special value for the manufacture of towing ropes.

Foreign Countries.—A well prepared sample of Zapupe fibre from Mexico was of good strength but irregular in length. If of a regular length of 4 ft. to 4 ft. 6 in., fibre of this quality would be of equal value to Mexican Sisal hemp, which was quoted at £34 15*s.* to £35 per ton. A second sample of this fibre was under examination at the close of the year.

Silk.

Rhodesia.—Several enquiries were dealt with relating to the establishment of a silk industry in Rhodesia and two samples of silk cocoons were examined. The results of the chemical examination were normal and satisfactory. A firm of silk reelers reported that although the cocoons were thin-walled, the reeling was excellent. The samples were too small to be valued commercially.

Ceylon.—Two samples of rather coarse silk were valued at about 12*s.* to 13*s.* per lb., with East Indian Surdah silk quoted at 11*s.* 3*d.* to 11*s.* 9*d.* per lb.

Foreign Countries.—Nests of wild silk from Mozambique proved to be similar to samples from Uganda and Southern

Nigeria previously examined at the Imperial Institute. The silk could not be reeled but might be converted into "spun silk," but it is doubtful if the price obtainable would render its collection profitable.

Flosses.

British West Africa.—A sample of Funtumia floss was not equal to kapok but could be used for similar purposes. It was valued at the current price of Calotropis floss, viz., 4½*d.* per lb.

Rhodesia.—A sample of kapok resembled ordinary Java kapok, and was valued at 6½*d.* to 6¾*d.* per lb., c.i.f. London (July, 1912).

Paper-making Materials.

Uganda.—A sample of "elephant" grass (*Pennisetum purpureum*, Schum.) was examined. It furnished a pulp of good colour and the ultimate fibres were as long as those of bamboo pulp and longer than those of esparto grass. The stems would be too bulky and light to be profitably exported to Europe, but if converted into pulp locally the latter would find a ready sale at about the same price as wood pulp prepared by the "soda" process, viz., £8 to £8 7*s.* 6*d.* per ton (London, November, 1912).

Union of South Africa.—A sample of *Scilla rigidifolia* leaves from the Transvaal contained a very weak fibre, which could not be profitably extracted for textile purposes, but could be used for paper making. For this purpose the leaves would realise about £2 17*s.* 6*d.* to £3 5*s.* per ton in the United Kingdom, but it would be more profitable to convert them into "half-stuff" for export or the leaves could be used for paper making in South Africa.

India.—A memorandum was supplied to the Government of Mysore on the use of bamboo for paper making.

Miscellaneous.

A number of fibres which do not come into any of the foregoing classes were also examined.

Samples of ramie strips and stalks from Cyprus had undergone partial decay and in consequence contained only an extremely weak fibre, which would be unsuitable for spinning. The strips of bark might possibly be worth about £5 per ton for paper making. Further samples of ramie strips from Cyprus, and samples of ramie and a so-called "nettle bark" from India were received for examination towards the end of the year.

Two samples of wool from Cyprus represented an excellent class of carpet wool, and material of this quality would meet with a ready sale in London. The samples were valued at 8*d.* to 8½*d.* and 9*d.* per lb. respectively.

A large number of enquiries from merchants and others in the United Kingdom, as well as from Colonial Governments and planters, were dealt with, relating to the cultivation, preparation and utilisation of various fibres, whilst a number of samples of flosses, paper-making materials, &c., were received for identification.

Rubber and Gutta Percha.

Countries of Origin.—Sudan, Uganda, Union of South Africa, Sierra Leone, Southern Nigeria, Mauritius, India, Ceylon, Federated Malay States, Commonwealth of Australia, Papua, West Indies, British Guiana, United Kingdom, Foreign Countries.

Sudan.—A small consignment of Landolphia biscuit rubber forwarded for sale was strong and mostly in good condition. It was sold through brokers in London at 4*s.* 5*d.* per lb., with fine hard Para at 4*s.* 6*d.* per lb.

A consignment of well-prepared Ceara biscuit rubber was also forwarded for sale, and realised 4*s.* 4¼*d.* per lb. in London, with fine hard Para at 4*s.* 10¾*d.* per lb.

Uganda.—Eight samples of rubber derived from Para, Funtumia and Ceara trees, and from the vines *Landolphia Dawei* and *Clitandra orientalis*, were examined. They were all of good quality and were valued at prices ranging from 4*s.* 7*d.* to 4*s.* 10*d.* per lb., with fine hard Para at 4*s.* 4½*d.* and "medium to palish" plantation crêpe rubber at 4*s.* 9*d.* to 5*s.* 0½*d.* per lb. Small lots of all these rubbers, except Funtumia, were subsequently sold in London, at a uniform price of 3*s.* 10*d.* per lb., with fine hard Para at 4*s.* 10*d.* per lb., the small size of the consignments preventing their realising their full value. A description of these rubbers has been published in the "Bulletin of the Imperial Institute," Vol. X. (1912), p. 11.

Union of South Africa.—A sample of *Landolphia Kirkii* rubber from Natal prepared by the Guiguet machine possessed fairly good physical properties and was valued at 3*s.* 9*d.* to 3*s.* 10*d.* per lb., with fine hard Para at 4*s.* 4½*d.* per lb. A sample of Landolphia scrap rubber received with the preceding sample was valued at 3*s.* 4*d.* to 3*s.* 6*d.* per lb.

The coagulated latex of *Conopharyngia elegans* from the Transvaal was a rather soft, sticky material, lacking the elasticity and tenacity of rubber. It was valued at £25 to £27 10*s.* per ton as a "gutta" of Almeidina type (February, 1912).

British West Africa.—A sample of clean, well-prepared Para rubber from Southern Nigeria possessed good physical properties and contained 93·0 per cent. of caoutchouc; it was valued in London at 4*s.* 10*d.* per lb., with fine hard Para at 4*s.* 10½*d.* per lb. Two other samples of Para rubber from Southern Nigeria contained respectively 94·3 and 96·5 per cent. of caoutchouc.

Mauritius.—A sample of the latex of *Euphorbia Tirucalli*, together with herbarium specimens, was under examination at the end of the year.

India.—Six samples of Para rubber from Burma were under examination at the close of the year.

Ceylon.—Five samples of Para rubber obtained by tapping in various ways were reported on. They were all of good quality and contained from 91·6 to 94·0 per cent. of caoutchouc. Two of the samples were valued at 4*s.* 6*d.*, and a third at 4*s.* 3*d.* per lb.,

with fine hard Para at 4*s*. 3*d*. per lb.; the other two samples were valued at 4*s*. 11*d*., with fine hard Para at 4*s*. 8*d*. per lb.

A sample of *Manihot dichotoma* rubber, the first to be prepared in Ceylon, consisted of four pieces, two of which exhibited fairly good physical properties, but the other two were soft, sticky and weak. The best pieces were valued at about 4*s*. per lb., with fine hard Para at 4*s*. 3*d*. per lb.

A sample of smoke-cured Para rubber prepared by Wickham's process was under examination at the close of the year.

Federated Malay States.—A sample of gutta percha probably derived from *Palaquium Gutta* was of very good quality and contained a higher percentage of gutta than is usually found in the best grades of commercial gutta percha. A second sample was under examination at the close of the year.

Papua.—Samples of the rubber of *Ficus Rigo* and of an indigenous vine were reported on. The former was satisfactory in chemical composition and physical properties, but was slightly sticky; it was valued at 3*s*. 10*d*. per lb. in London, with fine hard Para at 4*s*. 10*d*. per lb., but would realise a higher price than this if free from stickiness. The vine rubber was also sticky, but otherwise of fair quality, and if in good condition it would probably realise 3*s*. 6*d*. per lb. in London, with fine hard Para at 4*s*. 10*d*. per lb.

West Indies.—A consignment of the two-year-old stems of *Cryptostegia grandiflora* from Bahamas contained only 0·6 per cent. of caoutchouc, and it is very doubtful whether it would pay to extract the rubber from such stems by means of solvents, although older stems might give better results.

A sample of Para biscuit rubber from Dominica contained 93·9 per cent. of caoutchouc and possessed satisfactory physical properties. It was valued at 4*s*. 10*d*. per lb. in London, with fine hard Para at 4*s*. 4½*d*. and fair average plantation Para biscuits at 4*s*. 10¾*d*. to 4*s*. 11½*d*. per lb.

British Guiana.—A sample of *Hevea confusa* rubber was very satisfactory in composition, containing 92·3 per cent. of caoutchouc and only 1·8 per cent. of resin, but was deficient in physical properties. It was valued at 4*s*. per lb. in London, with fine hard Para at 4*s*. 8*d*. per lb.

A sample of "black balata" was under examination at the end of the year.

Foreign Countries.—Two samples of Ceara rubber from Mozambique were examined. One sample consisted of well-prepared biscuits exhibiting good physical properties; the other consisted of pressed scrap rubber prepared by the Lewa method and was of satisfactory strength. They were valued at 4*s*. 6*d*. and 3*s*. 6*d*. per lb. respectively, with fine hard Para at 4*s*. 4½*d*. per lb.

A number of samples of Landolphia bark from Mozambique and of Landolphia rubber prepared from the bark by mechanical treatment were also examined and reported on.

Waxes, Oils and Oil-seeds.

Countries of Origin.—Sudan, East Africa Protectorate, Uganda, Zanzibar, Rhodesia, Sierra Leone, Gold Coast, Northern

Nigeria, Southern Nigeria, India, Ceylon, Hong Kong, British North Borneo, West Indies, British Honduras, United Kingdom, Foreign Countries.

Baobab Seed (*Adansonia digitata*).—A sample of these seeds from the East Africa Protectorate yielded only 11·6 per cent. of a clear, viscous, bright yellow oil, and they would consequently be of no value in Europe as an oil-seed.

Bassia spp.—"Mee" kernels (*Bassia longifolia*) from Ceylon contained 47·8 per cent. of fat, which is a higher proportion than is usually present in kernels of this species (Mowra kernels) from India. The kernels were valued at £12 5*s*. to £12 10*s*. per ton (May, 1912), and consignments would sell readily in this country.

A herbarium specimen of the "Katiau" plant, the kernels of which contain a fat closely resembling that of the kernels of *Bassia latifolia* was received from British North Borneo and was identified at the Royal Botanic Gardens, Kew, as a form of *Bassia Mottleyana*, C. B. Clarke.

Beeswax.—Four samples of beeswax from the Sudan consisted of two of crude wax as brought in by the natives and two of clean wax prepared from the crude waxes. The former were unsuitable for export but the clean waxes were valued at about £6 10*s*. and £6 12*s*. 6*d*. per cwt. Another sample from the Sudan consisted of pale coloured wax free from any appreciable amount of dirt, except on the exterior, and was valued at £7 5*s*. per cwt.

Beeswax and specimens of bees were received from Northern Nigeria and were under examination at the end of the year.

Ben Oil Seed (*Moringa pterygosperma*).—A sample of these seeds from the East Africa Protectorate was similar to previous samples from Jamaica and Northern Nigeria (*see* Report for 1910 [Cd. 5467-23], p. 29). The sound kernels yielded 39·2 per cent. of yellowish oil suitable for soap-making. This oil has been recommended for lubricating clocks, but experiments extending over 18 months with oil extracted from Ben seeds from Northern Nigeria showed that it is unsuitable for this purpose as it becomes thick and sticky after a time.

Ben seeds from Zanzibar were under examination at the end of the year.

Castor Seed.—A sample of small grey castor seed from the Sudan yielded 43·3 per cent. of oil, and was valued at £10 12*s*. 6*d*. per ton (January, 1912). A small consignment of castor seed from the Sudan was sold in Hull at the rate of £12 5*s*. per ton, the current price of Bombay castor seed (June, 1912). Castor seed from the East Africa Protectorate consisted of mixed seed derived from two varieties of *Ricinus communis*, which could not be identified with certainty in the absence of herbarium specimens, but were probably var. *megalosperma* and var. *africana* respectively. The mixed seed yielded 49·2 per cent. of oil, and was valued at £12 per ton (March, 1912).

Native prepared castor oil from Rhodesia was too crudely prepared to be suitable for sale in Europe.

Five samples of castor seed from Mozambique were of satisfactory quality and yielded from 41·9 to 49·6 per cent. of oil. Consignments of similar quality would be readily saleable in

Europe at prices approximating to that of Bombay castor seed.

Castor seed from Zanzibar was under examination at the close of the year.

Coconuts.—Specimens of diseased coconut palms from the East Africa Protectorate were found to be attacked by a fungus which was identified at the Royal Botanic Gardens, Kew, as *Diplodia epicoccus*, Cooke, but it was not possible to determine whether this was the primary cause of the disease.

A memorandum on the destruction of coconut palm pests was supplied to the Government of Zanzibar.

Cheyi Seed (*Polygala butyracea*).—A sample of these seeds from Northern Nigeria yielded 37·9 per cent. of soft, yellowish fat. The seeds were valued at about half the price of copra, which was then selling in the United Kingdom at £25 to £28 per ton (November, 1912).

Cohune Kernels (*Attalea Cohune*).—The kernels of Cohune fruits from British Honduras yielded 71·8 per cent. of solid white fat resembling coconut oil. The kernels if shipped to the United Kingdom should realise about the same price as copra of fair quality.

Three samples of Cohune fruits and two of kernels from British Honduras were under examination at the close of the year.

Ground Nuts.—Eight samples of ground nuts grown experimentally in Montserrat were examined. They were of rather poor quality and were valued in Liverpool for edible use at prices ranging from 9*s.* to 12*s.* 6*d.* per cwt., with unshelled Coromandel nuts at 13*s.* to 14*s.* per cwt. and Rufisque ground nuts at 17*s.* per cwt.

Samples of ground nuts and ground nut kernels from Rhodesia were valued in Liverpool at £16 to £17 and £14 to £15 per ton respectively (January, 1912), whilst a sample of native-prepared ground nut oil was too crude to be of value for export.

Four samples of ground nut oil from Hong Kong were valued at prices ranging from £28 to £30 per ton, with finest ground-nut oil at £38 to £45 per ton.

Ground nuts from Zanzibar were under examination at the end of the year.

Hemp Seed.—A sample of hemp seed from Hong Kong contained 28·2 per cent. of oil and was valued for extraction of oil at £8 5*s.* per ton in Europe, with "good" hemp seed at £9 to £9 10*s.* per ton; a limited quantity would probably be saleable as a bird seed at £10 per ton.

Linseed.—Linseed from the East Africa Protectorate consisted of ordinary clean seed of fair size. If exported in small lots, up to about 30 tons, such seed would realise about 71*s.* per quarter of 416 lb. for feeding purposes, but larger consignments would compete with Bombay seed for crushing and would be worth about 69*s.* per quarter (June, 1912).

"*Kaku*" *Seeds* (*Lophira procera*).—A sample of these seeds from the Gold Coast contained 75 per cent. of kernel, which yielded 55·3 per cent. of cream-coloured, solid fat. The latter would be of about the same value as cotton seed oil for soap

making, but the residual cake has a bitter taste and would not be worth more than 35*s*. per cwt. as a manure. The kernels were valued at about £12 per ton in Liverpool (February, 1912).

Margosa Seed.—Samples of unshelled margosa seed from India and Ceylon were reported on. The former was not in good condition and yielded only 23·5 per cent. of fat (48·9 per cent. from the kernels), as compared with 31·0 per cent. (59·25 per cent. from the kernels) in the case of the Ceylon seed. The fat as expressed from the seeds was of poor quality for soap-making purposes on account of its dark colour and very unpleasant odour. Experiments were in progress at the end of the year to ascertain whether the odour could be removed by some simple process.

Oil Palm Products.—A sample of fibrous residue produced in experiments with the Gwira palm oil machine in the Gold Coast Colony was found to contain 40 per cent. of oil, calculated on the dry fibrous residue, as compared with 30 per cent. in the fibrous residue obtained in the ordinary native method of extracting palm oil. The palm fruits used in this experiment were also examined. They were of the ordinary thick-shelled variety, with 30 to 31 per cent. of pulp (pericarp) which contained 72·1 per cent. of oil and 5 per cent. of moisture as received at the Imperial Institute.

Three samples of palm oil produced in an extraction experiment in the Gold Coast were reported on. Those prepared from fresh fruits and from fruits kept for eight days were "soft" oils with acid values of 8·4 and 13·2 respectively, whilst that obtained from fruits kept for six weeks was a "hard" oil with an acid value of 103·7.

A sample of palm fruit known as "Ayara Mbana" from Southern Nigeria differed from the ordinary palm fruit in possessing a thick, fleshy perianth which contained 69·9 per cent. of oil (14·8 per cent. expressed on the whole fruit), whilst the ordinary pulp of the fruit contained 76·1 per cent. of oil (27·2 per cent. expressed on the whole fruit).

A sample of palm nuts from Zanzibar was received for examination towards the close of the year.

Pentadesma butyracea.—Seed-kernels of this tree from Southern Nigeria contained, when air-dried, 10·6 per cent. of moisture and 40 per cent. of solid, yellowish fat. The latter would be suitable for soap making, if refined, and good dry kernels of similar quality to this sample would be worth £8 to £10 per ton in the United Kingdom.

P. butyracea seeds from the Gold Coast were under examination at the end of the year.

Para Rubber Seed.—A sample of Para rubber seed-kernels from Ceylon yielded 45 per cent. of oil, which is normal for this product.

Salvadora persica Seed.—A specimen of these seeds from the Sudan yielded 44·6 per cent. of hard, bright yellow fat, which possessed a bitter taste and a slightly unpleasant odour. The fat would be suitable for the manufacture of candles, and if the unpleasant taste and odour could be removed, possibly also for the manufacture of edible fats.

Senat Seed.—A sample of senat seed from the Sudan, herbarium specimens of three varieties of the senat plant and two samples of the husks of the pods were reported on. An account of the examination of these materials and of those examined in previous years has been published in the "Bulletin of the Imperial Institute," Vol. XI. (1913), p. 58.

Sesamum Seed.—Two samples of small white sesamum seed from the Sudan were of good quality and were valued respectively at about £17 per ton with large white Bombay seed quoted at £19 per ton, and at £17 10*s.* per ton with large white Bombay seed at £17 7*s.* 6*d.* per ton.

Sesamum seed from Zanzibar was under examination at the close of the year.

Shea Nuts (*Butyrospermum Parkii*).—Shea kernels in good condition were received from Uganda and the Gold Coast. Consignments of similar quality should realise the current market price, viz., £10 10*s.* per ton in Liverpool (April, 1912). Shea butter from the Gold Coast was also of good quality and was valued at £28 5*s.* per ton in Liverpool (April, 1912).

Shea kernels from the Sudan were under examination at the end of the year.

Soy Beans.—Four samples of soy beans from Hong Kong were in good condition and contained less moisture than those commonly imported into Europe from Manchuria. They were valued at prices ranging from £7 10*s.* to £8 per ton in the United Kingdom (February, 1912). Soy bean oil from Hong Kong was of excellent quality and was valued at £23 5*s.* per ton (February, 1912). Soy beans from Ceylon were also reported on.

Sterculia fœtida Seed.—The seed-kernels of *S. fœtida* fruits from Ceylon yielded 52·1 per cent. of pale brownish-yellow oil, which has certain peculiar properties and is being further investigated.

Tea Seed (*Camellia Sasanqua*).—A sample of tea-seed oil from Hong Kong consisted of a yellowish-brown, slightly opalescent oil which would be suitable for soap-making. It was valued at about £1 per ton less than cotton-seed oil which was then quoted at £22 2*s.* 6*d.* per ton in Hull (February, 1912).

Telfairia pedata Seed.—A sample of this seed from Zanzibar contained 51 per cent. of kernel, which yielded 56·9 per cent. of oil suitable for soap-making. If prepared from the kernels alone the oil might possibly be utilised for edible purposes, but so far there is no machine available for shelling the seeds and the prospects of utilising them are not promising. A second sample from Zanzibar and one from Uganda were received for examination at the close of the year.

Miscellaneous.—Other oil-seeds and oils examined and reported on during the year included "Raina" seeds (*Amoora Rohituka*), "Nahar" seeds (*Mesua ferrea*), "Panang" seeds (*Calophyllum Inophyllum*), and "Taramani" seeds (*Eruca sativa*) from Bengal; "Tai Fung Chi Yau" oil (*Hydnocarpus* sp.), Chinese vegetable oil from Hong Kong; and fruits and oil of an undescribed species of Balanites from Portuguese East Africa. A

series of eight samples of fish oils and stearin from Madras and a sample of lard from Rhodesia were also examined, whilst a number of specimens of oil-seeds were received for identification.

As in previous years a large number of enquiries were dealt with from merchants, planters and others relating to the cultivation and utilisation of different oil-seeds.

The material under investigation at the close of the year, in addition to that already mentioned, included *Jatropha Curcas* seed from Zanzibar, safflower seed from Nyasaland, further samples of "Raina" seeds and "Panang" kernels from India, and sugar-cane wax from Barbados.

Volatile Oils.

Countries of Origin.—Cyprus, Sudan, East Africa Protectorate, Uganda, Rhodesia, Union of South Africa, Mauritius, India, Federated Malay States, Hong Kong, Commonwealth of Australia, Fiji Islands, West Indies, United Kingdom.

Cyprus.—A sample of "juniper" oil distilled from the crushed berries of *Juniperus phoenicea* was found to differ from ordinary juniper berry oil in odour, optical rotation and solubility in alcohol, and would not be saleable in Europe as a juniper berry oil. A specimen of the plant yielding Cyprus "sage oil" was received for determination and was identified at the Royal Botanic Gardens, Kew, as *Salvia cypria*, Unger et Kotschy.

Sudan.—*Cymbopogon senaarensis* grass was under investigation at the close of the year.

Uganda.—A botanical specimen of the plant furnishing Uganda lemon grass oil was received and submitted to the Royal Botanic Gardens, Kew, where it was identified as *Cymbopogon citratus*, Stapf.

Union of South Africa.—A sample of Sherungulu tubers from the Transvaal was under examination at the close of the year.

Mauritius.—Eucalyptus and camphor oils and champac essence were received for examination towards the end of the year.

India.—Three turpentine oils distilled from the oleo-resin of *Pinus longifolia*, Roxb., were examined. Two of them were superior to any sample of Indian Turpentine oil previously examined at the Imperial Institute, but none of them would be accepted in commerce as similar to the best grades of American or French oils and their examination confirms the conclusion previously arrived at that the Indian *P. longifolia* oil would have to be put on the market on its own merits and would probably realise a price equal to or somewhat better than that of Russian oil.

Turpentine oils obtained from *P. excelsa*, Wall., and *P. Khasya*, Royle, were also examined. The former consisted mainly of dextro-pinene and if re-distilled would be equal to the best grades of French and American oils, whilst the latter appeared to be a mixture of terpenes and would probably rank with the lower grades of American oil.

Four lemon grass oils contained from 72·2 to 81·5 per cent. of citral, and small consignments of these oils were sold in London

at a uniform rate of 4*d*. per oz., when oil of normal quality was quoted at 4½*d*. per oz.

A sample of vetiver roots yielded only 0·26 per cent. of oil by the ordinary distillation process, and as the oil was of somewhat abnormal character, it is doubtful whether such roots could be sold readily in Europe in competition with roots of better quality from other sources.

The wood of *Cinnamomum glanduliferum* (Nepal camphor wood) was found to yield 2·95 per cent. of pale yellow oil possessing an odour resembling that of sassafras, and consisting almost entirely of safrole, myristicin and elemicin (see *Trans. Chem. Soc.*, 1912, 101, 1433). The oil might possibly be used as a substitute for sassafras oil, for which purpose it would be worth about 2*s*. 2*d*. per lb., but as there is little demand for this at present, it would probably only find a market as a source of safrole or as a perfume for cheap soaps. For the two last-named purposes the oil was valued at 4*d*. and 6*d*. per lb. respectively.

Memoranda were supplied to Government officials in India relating to the marketing of sandalwood in Europe and the distillation of Rusa grass.

Federated Malay States.—Camphor oil and crude camphor obtained from plants grown experimentally were under examination at the close of the year.

Hong Kong.—A series of eight samples of volatile oils, including citronella, peppermint and camphor oils, was reported on.

The oil obtained from the fruits of *Alpinia alba* (*Amomum medium*) was under investigation at the close of the year.

Fiji.—A small consignment of *Cymbopogon coloratus* oil was under examination at the close of the year.

Foodstuffs and Fodders.

Countries of Origin.—Sudan, Somaliland, East Africa Protectorate, Uganda, Zanzibar, Nyasaland, Rhodesia, Union of South Africa, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, Mauritius, India, Ceylon, Hong Kong, British North Borneo, Labuan, West Indies, British Honduras, United Kingdom, Foreign Countries.

Cereals.

The investigation carried out under the auspices of the Imperial Institute as to the utilisation of Sudan dura in Europe was concluded during the year. Technical trials were made by starch and glucose manufacturers, brewers and distillers, and feeding trials with cattle and sheep were carried out at Durham University and at the South-Eastern Agricultural College, Wye. Full details of the investigation have been published in the "Bulletin of the Imperial Institute," Vol. XI. (1913), p. 33.

A sample of wheat from the East Africa Protectorate, which had been grown from Russian seed, had improved somewhat under East African conditions as compared with the original grain, and was valued at 40*s*. to 41*s*. per quarter of 480 lb. c.i.f. United Kingdom ports (July, 1912).

A sample of maize from Southern Nigeria which had been exposed to a temperature of 140° F. in order to effect the destruction of weevils was found to have suffered very little from the high temperature, the germinating power of the grain being only slightly affected, but so far as weevil destruction was concerned the experiment was not conclusive. The maize was valued at £6 5s. per ton in London and 6s. 5d. to 6s. 6d. per 100 lb. ex quay Liverpool (April, 1912).

A sample of unhusked rice from the Sudan was superior to Rangoon rice, and the husked product of similar quality should find a ready market in London. A sample of unpolished, husked rice from British Honduras had not been well prepared, but material similar to the best grains in the sample should meet with a ready sale in London.

Maize, rice, dura, and various millets from Zanzibar were under examination at the close of the year.

Leguminous Seeds.

Six varieties of beans from the Sudan were examined. They were all in good condition but most of the samples were somewhat dusty. The chemical composition compared favourably with that of similar beans of commerce, and they were valued at prices ranging from £5 10*s*. to £6 10*s*. per ton for *Dolichos Lablab*, *Cajanus indicus*, and *Phaseolus Mungo*, and £6 15*s*. per ton for *Vicia Faba*, up to £8 10*s*. per ton for *Vigna sinensis* and £10 10*s*. per ton for *Phaseolus vulgaris* (October, 1912).

A series of beans from Hong Kong was also examined. These were valued as follows:—*Dolichos Lablab* £6 to £7 per ton (March, 1912), *Vigna sinensis* £8 per ton, two red varieties of *Phaseolus Mungo* £6 12*s*. 6*d*. per ton, and a green variety of this bean £6 15*s*. per ton.

The leguminous seeds under examination at the end of the year included *Stizolobium niveum*, *S. aterrimum*, lentils, and chick peas from Nyasaland, *Vigna* sp., *Phaseolus* sp., *Dolichos Lablab*, *Cajanus indicus* and *Voandzeia subterranea* from Zanzibar, and *Stizolobium aterrimum* from St. Vincent.

Tea, Coffee, and Cocoa.

Two samples of tea from Southern Nigeria were of very promising character, and were valued at 9*d*. to 9½*d*. and 10*d*. to 10½*d*. per lb. respectively, with average quality Indian tea at about 8½*d*. per lb. A third sample arrived in a mouldy condition, but if sound would have been worth 9*d*. per lb. in London.

Two samples of coffee from the East Africa Protectorate consisted of rather small beans, but would be readily saleable in this country. They were valued at 68*s*. and 65*s*. to 66*s*. per cwt. respectively in London (April, 1912).

Three samples of coffee from Uganda were of promising quality, but could have been improved by more careful grading and cleaning. They were regarded as worth from 70*s*. to 72*s*. per cwt. with Central American coffee at 77*s*. to 85*s*. per cwt.

A sample of coffee from Rhodesia was of good quality and if thoroughly dried and shipped in the parchment consignments

should realise from 74*s*. to 85*s*. per cwt., according to size of berrie.

A sample of Abyssinian coffee was received from the Sudan towards the close of the year.

In continuation of the experiments on the preparation of cocoa beans in the Gold Coast, four samples of cocoa were examined. Fermented Amelonado and Cundeamor cocoas were valued in Liverpool at 57*s*. to 58*s*., and 57*s*. to 60*s*. per cwt. respectively, and two samples of unfermented Amelonado cocoa were valued at 53*s*. to 54*s*. per cwt. The results of the enquiry indicated that unfermented cocoa, if otherwise in good condition, can be sold in the United Kingdom and on the Continent, but that manufacturers prefer fermented cocoa.

A sample of unfermented cocoa from Southern Nigeria was also examined.

Miscellaneous.

Feeding trials with Mafoureira seed cake from Mozambique were reported on during the year. It was found impossible to induce sheep to eat the cake, even when mixed with other feeding stuffs, owing to its intensely bitter taste. The cake may, however, prove of value as a manure and manurial trials were arranged for during the year.

Two samples of Para rubber seed cake from Ceylon were examined and feeding trials with the cake were in progress during the year.

A series of six samples of millet and guinea corn stems and leaves from Northern Nigeria was examined. In one case a trace of prussic acid, equivalent to 0·003 per cent. expressed on the weight of the sample as received, was found. A second set of samples was under investigation at the close of the year.

A sample of maize refuse from Nyasaland contained a fair quantity of fat and carbohydrates but the percentage of nitrogen was low. In admixture with materials richer in proteins it could be used as a food for cattle.

A sample of arrowroot from the Gold Coast was of good quality, being valued at 3*d*. per lb. in London with St. Vincent arrowroot at 3½*d*. to 3¾*d*. per lb., whilst a sample of cassava starch from the same Colony was valued at £14 to £15 per ton for use in certain textile industries and would probably sell in large quantities in the United Kingdom in competition with tapioca flour at £12 to £15 per ton.

The seeds of a species of Musa from the East Africa Protectorate were found to contain 40·5 per cent. of flour, similar in composition to wheat flour, but containing rather less proteins and more carbohydrates. The flour should form a nutritious food, but some difficulty would probably be experienced in preparing it for the market.

Other investigations relating to foodstuffs completed during the year included grape fruit, lemons and oranges from the East Africa Protectorate, dates from the Sudan, and dried papaw fruit from the East Africa Protectorate.

Numerous enquiries from merchants and others in this country and from Colonial and Indian Governments and planters were dealt with. Many of these enquiries related to coffee and cocoa cultivation, cassava and other starches, sugar-cane cultivation, etc., whilst a number of specimens of food grains and other foodstuffs were received for identification.

In addition to the products already referred to samples of lemons from the East Africa Protectorate were under investigation at the close of the year.

Spices.

Countries of Origin.—Sudan, East Africa Protectorate, Zanzibar, Rhodesia, Gold Coast, Southern Nigeria, Hong Kong, United Kingdom.

Two samples of coriand[illegible] grown from Indian seed in the East Africa Protectorate [illegible] only small percentages of oil but the seed could be used as [illegible]attle spice, for which purpose the samples were valued at 7*s.* to 8*s.*, and 6*s.* to 7*s.* per cwt. respectively.

Four samples of cloves from Zanzibar were examined. Three of them had been artificially dried and yielded from 13·33 to 14·80 per cent. of oil; the fourth had been sun-dried and yielded 16·55 per cent. of oil. The former were of better appearance and were valued at prices ranging from 5½*d.* to 6½*d.* per lb., and the latter at 5¼*d.* per lb. (January, 1912).

A sample of cinnamon bark from Southern Nigeria was very aromatic, but it had not been properly prepared and would be of comparatively low commercial value.

Chillies from Rhodesia and the Gold Coast Colony were examined. The former sample contained a certain amount of stalk and was valued at 25*s.* per cwt. in London (June, 1912), or 35*s.* per cwt. with the stalks removed before shipment. The Gold Coast sample consisted of a mixture of red and yellow pods, a large proportion being unripe. It was valued at 15*s.* to 20*s.* per cwt., and if free from unripe pods, at 25*s.* per cwt. (May, 1912).

A sample of black pepper from the Gold Coast was of fair quality, and worth 5*d.* to 5½*d.* per lb. (March, 1912).

A sample of "guinea grains" from the Gold Coast and a sample of the whole pods from Southern Nigeria were examined. The seeds in each case were in good condition but the demand for them at the present time is limited and any increase in the supply at once brings down the price of this product, so that there is little likelihood of large quantities being profitably exported from these countries.

Samples of ginger from Hong Kong and the Sudan were reported on, whilst samples of ginger and capsicums from Zanzibar were under examination at the close of the year.

Tobaccos.

Countries of Origin.—Malta, Somaliland, Uganda, Papua, Bermuda, United Kingdom, Foreign Countries.

Somaliland.—A sample of tobacco proved to be of poor quality judged by European standards, and would not be saleable in the United Kingdom.

Papua.—Two samples of cigar tobaccos of Havana and Sumatra types were examined. Neither sample was quite suitable for cigar wrappers but they were otherwise of good quality and burnt well, and consignments similar to these samples would be readily saleable in the United Kingdom. The tobaccos were valued at 9*d.* per lb. in London (July, 1912) if marketed in dry and sound condition.

Bermuda.—A sample from a stock of tobacco which had been stored since 1908 was reported on. The tobacco when examined at the Imperial Institute in that year proved to be of poor quality and the present sample showed little improvement after storage for four years. It was valued at 6*d.* to 7*d.* per lb. as "bunch wrappers" for cigar manufacture, and at less than 6*d.* per lb. as a "cutting" tobacco.

Foreign Countries.—A series of six samples of "Virginian" tobacco from Mozambique was under examination at the end of the year.

Gums and Resins.

Countries of Origin.—Sudan, Somaliland, East Africa Protectorate, Rhodesia, Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria, Mauritius, India, Federated Malay States and Straits Settlements, Commonwealth of Australia, New Zealand, British Honduras, United Kingdom, Foreign Countries.

A sample of "wood-oil," stated to consist of the "sap" of the Kruing tree (*Dipterocarpus crinitus*) from the Federated Malay States, yielded on steam distillation 19·5 per cent. of volatile oil, the residue consisting of a brownish-white resin. The material resembled "gurjun" balsam in certain respects but contained less oil and could not be used as a substitute for it.

Four copals from Mozambique, collected from the "Mgeji" tree (*Copaifera Gorskiana*, Benth.) were of good quality and consignments in similar condition would be readily saleable in London. They were valued at prices ranging from 25*s.* to £5 per cwt. according to grade.

Other products of this kind examined during the year included "Mutanga" gum from the East Africa Protectorate and a "gum" from New Zealand, whilst four herbarium specimens of gum trees from Northern Nigeria were received for identification.

The materials under examination at the end of the year included frankincense and Gafal gum from the Sudan, a series of gums, gum-resins and resins from Somaliland, oleo-resins of *Daniella thurifera* from the Gold Coast and Northern Nigeria, gums and herbarium specimens of gum trees from Northern Nigeria, and various resins from India.

Drugs and Poisonous Plants.

Countries of Origin.—Sudan, Somaliland, East Africa Protectorate, Uganda, Zanzibar, Nyasaland, Rhodesia, Union of

South Africa, Gambia, Sierra Leone, Northern Nigeria, Southern Nigeria, India, Ceylon, Federated Malay States, Commonwealth of Australia, Canada, West Indies, United Kingdom, Foreign Countries.

Union of South Africa.—A sample of *Barosma venusta* leaves from the Cape Province was examined with a view to ascertaining the possibility of employing them as a substitute for ordinary buchu leaves. The yield of oil was found to be higher than in the case of ordinary buchu leaves, viz., 2·7 per cent., as compared with 1·3 to 2·0 per cent. in the case of *B. betulina* and 0·8 to 1·0 per cent. in the case of *B. serratifolia*, but the oil is quite different from buchu oil and it seems likely that *B. venusta* could not be used in medicine as a substitute for ordinary buchu leaves.

Amongst South African drugs and poisonous plants under examination at the close of the year were *Dichapetalum cymosum*, *Acokanthera venenata*, *Crotalaria Burkeana*, *Leonotis Leonurus*, and *Homeria pallida* from the Transvaal. "slangkop" bulbs and leaves from Cape Province, and *Chrysophyllum viridifolium* bark from Natal.

British West Africa.—The examination of two native drugs from Sierra Leone was completed during the year. A sample of "anet," identified at the Royal Botanic Gardens, Kew, as possibly *Tetracera obtusata*, was found to contain no active constituents. Alkaloids were either absent or present only in minute traces, insufficient to exert any medicinal action; physiological trials also gave negative results, and it is improbable that "anet" leaves have any medicinal value. Similarly, no active constituent could be isolated from a sample of "tatuookroo," a species of *Cnestis*, and it seems that this plant also possesses no medicinal value. A third native drug from Sierra Leone, "bitter leaf plant" (*Vernonia amygdalina*), was under investigation at the close of the year.

Other West African plants received or under examination during the year included "bitter kola" specimens from Southern Nigeria, which were identified at Kew as *Garcinia Conrauana*, Engl. (= *G. Cola*, Heckel); a poisonous plant from Gambia, which proved to be a species of Datura, probably *D. fastuosa*; and "gigeya" plant from Northern Nigeria.

India.—A full report on the results of examination of a large number of samples of opium and poppy plants from the chief opium growing districts of India was in preparation during the year, whilst other drugs and poisonous plants from India under investigation included the roots of *Podophyllum Emodi*, *Thalictrum foliolosum*, the seeds of *Schleichera trijuga* and *Peganum Harmala* and a number of samples of aconite roots.

Federated Malay States.—A sample of "Truxillo" coca leaves reported on in 1911 was submitted to further examination. The "ether soluble alkaloids," which were present to the extent of 1·25 per cent., were found to consist of approximately 87 per cent. cocaine, 11 per cent. cinnamoylcocaine or other oxidisable alkaloid, and not more than 2 per cent. of an alkaloid which is probably "truxilline."

Commonwealth of Australia.—Two samples of poisonous "tulps" from South Australia were examined. One was described as *Homeria collina* and the other as *H. miniata*, but according to the *Index Kewensis* these two species are botanically identical. No toxic substances could be detected on analysis in either case, but extracts prepared by various methods were markedly toxic to frogs, although not to mammals, so that a poisonous substance may be present in very small amount. It is possible that the plants are only specially poisonous to cattle at certain stages of their growth, and as further investigation on this point was necessary another sample of *H. miniata* was received for examination towards the close of the year.

Other Australian drugs under examination at the end of the year were the barks of *Daphnandra micrantha* and *Zanthoxylum brachyacanthum*.

Miscellaneous.—The drugs and poisonous plants under examination at the close of the year, in addition to those already mentioned, included *Leonotis pallida* from the Sudan, *Croton Elliottianus* seeds from the East Africa Protectorate, *Caesalpinia Bonducella* seeds from Zanzibar, a medicinal root from Nyasaland, the seeds and leaves of *Tephrosia Vogelii* from Rhodesia, *Adhatoda Vasica* leaves from Ceylon, *Senecio Jacobaea* from Canada, and "mudata" bark from Mozambique, whilst botanical specimens of various medicinal barks from Uganda were also received for identification.

Tanning Materials and Dyes.

Countries of Origin.—Sudan, Somaliland, East Africa Protectorate, Uganda, Zanzibar, Rhodesia, Union of South Africa, Sierra Leone, Northern Nigeria, Southern Nigeria, India, Ceylon, Hong Kong, Commonwealth of Australia, New Zealand, Fiji Islands, West Indies, United Kingdom, Foreign Countries.

Sudan.—A sample of "sant grains" prepared from "sant" pods, the fruits of *Acacia arabica*, contained 54·5 per cent. of tannin. Technical trials with the "sant grains" were arranged for but these were not completed at the close of the year. A sample of powdered bark of *Anogeissus leiocarpus* contained only 9·6 per cent. of tannin and could therefore not be profitably exported although the bark could be used locally. A sample consisting of a mixture of the above powders contained 24·3 per cent. of tannin, but such material is unlikely to meet with any demand in the United Kingdom. A sample of "sant" pods was received for examination at the close of the year.

Somaliland.—A sample of "marra" bark was under investigation at the end of the year.

East Africa Protectorate.—A consignment of black wattle bark in quills about 3 feet long and varying in thickness from $\frac{1}{8}$ to $\frac{1}{4}$ inch was examined. An average sample from the consignment yielded 35·7 per cent. of tannin, the thicker bark yielding 43·1 per cent. The small size of the consignment made it difficult to dispose of, but it was eventually sold in London at the rate of £7 10*s.* per ton, with chopped Natal wattle bark at £8 to £8 10*s.* per ton. A sample of black wattle bark obtained from

a tree 5½ years old consisted of quills varying in thickness from $\frac{1}{16}$ to ¼ inch. A representative portion contained 30·5 per cent. of tannin, the percentage in the thin and the thick bark being 29·4 and 34·1 respectively. Five further samples of wattle bark were under examination at the close of the year.

Zanzibar.—A sample of annatto seed (*Bixa orellana*) was under examination at the end of the year.

Rhodesia.—A sample of pods used by natives in dyeing was found to contain 22·7 per cent. of tannin in the whole pods and 36·0 per cent. in the pod-cases. The latter might be worth exporting if available in large quantities. The dyeing properties of the pods are due to the action of the tannin in conjunction with iron salts or ferruginous earth.

Union of South Africa.—A sample of the pods of *Acacia arabica* var. *Kraussiana* yielded 19·6 per cent. of tannin and would not be worth exporting to this country. An infusion of the pods gave a rather stiff, greyish-brown leather of firm texture, but if used in conjunction with some other tanning material of better colour, the pods might prove satisfactory for use in South Africa.

British West Africa.—Eight samples of mangrove barks from Southern Nigeria were reported on. The percentage of tannin varied from 12·6 to 27·7 in the different specimens, and although two of the samples contained a higher percentage of tannin than is usual in West African mangrove barks they would not be worth exporting to Europe in competition with the East African bark.

India.—A sample of extract (cutch) prepared from *Acacia Catechu* contained 53·3 per cent. of moisture and 32·5 per cent. of tannin. If the amount of moisture could be reduced to 15 per cent. the extract would be comparable to commercial Indian cutch, the value of the ordinary to fair quality of which was £20 to £26 per ton (London, June, 1912).

Ceylon.—A sample of *Terminalia glabra* bark was under examination at the end of the year.

Hong Kong.—A sample of the leaves of *Phyllanthus Emblica* produced a leather of good quality, but as they contained only 16·8 per cent. of tannin they would not be valuable enough for export to Europe. A sample of Chinese gall nuts of excellent quality contained 61·5 per cent. of tannin and was valued at £55 to £60 per ton ex ship London, with ordinary Chinese gall nuts at £49 to £52 10*s.* per ton.

Commonwealth of Australia.—A sample of the bark of the celery top pine (*Phyllocladus rhomboidalis*) from Tasmania contained 20 per cent. of tannin. This amount is too low to enable the bark to be profitably exported, but the latter would be quite suitable for local use or for the manufacture of extract.

Fiji.—Three samples of mangrove extract were too dark coloured to be suitable for tanning leather, but they could be used for dyeing sails, fishing nets, &c. They contained respectively 59·5, 55·3 and 69·4 per cent. of tannin and 26·3, 15·8 and 13·1 per cent. of moisture; the first two were valued at £14 per ton, c.i.f. Liverpool (June 1912).

United Kingdom.—Many enquiries as to the utilisation of various tanning materials were dealt with, a large number rela-

ting to species of Caesalpinia, *e.g.*, *C. tinctoria*, *C. digyna* ("teri") and *C. coriaria* ("divi-divi"). A sample of the whole pods of the first-named species was received for examination and found to consist of 54 per cent. pod-cases and 46 per cent. seeds. The pod-cases contained 46·5 per cent. of tannin, equivalent to 25 per cent. in the whole pods.

Foreign Countries.—Three samples of Brachystegia bark from Mozambique were too poor in tannin to be worth exporting to Europe. A sample of Landolphia bark from which the rubber had been extracted was also received from Mozambique. It contained only 6 per cent. of tannin and was unsuitable for use as a tanning agent.

Timbers.

Countries of Origin.—Cyprus, East Africa Protectorate, Uganda, Union of South Africa, Southern Nigeria, India, British Guiana, British Honduras, United Kingdom, Foreign Countries.

Uganda.—A sample of "Mukokoto" timber proved to be similar to timbers commonly used in the tropics for making packing cases, and as it possessed no decorative qualities it could not be shipped profitably to Europe. Herbarium specimens of the tree yielding this timber were also received and were identified as probably a new species of *Pterygota*.

British West Africa.—Samples of "Obeche" timber (*Triplochiton Johnsonii*) and teak from Southern Nigeria were under examination towards the close of the year.

India.—Information was supplied to the Government of India on the manufacture of "synthetic" timber from waste soft woods.

West Indies.—The investigation of the constituents of West Indian satinwood (*Zanthoxylum flavum*) referred to in last year's Report, p. 43, was completed during the year and a summary of the results was published in the "Bulletin of the Imperial Institute," Vol. X. (1912), p. 297. Two crystalline substances and a number of resins were obtained by extracting the sawdust successively with light petroleum and alcohol, and specimens of these were sent to Professor Cash, of Aberdeen University, for pharmacological trials.

Foreign Countries.—A sample of M'Zimbiti wood (*Androstachys Johnsonii*) from Mozambique was found to be a hard, close-grained wood, most closely resembling boxwood amongst British timbers. It could probably be used for various kinds of turnery if imported cheaply enough to compete with other woods of similar texture.

Miscellaneous.—Amongst enquiries from merchants and others in this country as to the utilisation of various timbers were a number relating to the destructive distillation of waste wood. Enquiries on this subject were also dealt with from Cyprus and the East Africa Protectorate.

Miscellaneous Specimens.

Countries of Origin.—Cyprus, Sudan, Uganda, East Africa Protectorate, Zanzibar, Rhodesia, Union of South Africa, Sierra Leone, Northern Nigeria, Mauritius, India, Ceylon, Hong Kong, Commonwealth of Australia, Solomon Islands, United Kingdom, Foreign Countries.

A number of vegetable and animal products which do not readily fall into any of the preceding classes were examined during the year. The materials of animal origin included buffalo and ox leathers, fish glue and cow glue from Hong Kong, ostrich feathers and mother-of-pearl shells from the Sudan, and mole skins from Rhodesia. A memorandum was supplied to the Government of India on the possibility of finding a market for rat skins in the United Kingdom. A number of enquiries from private persons and firms regarding animal products were also dealt with.

Several samples of vegetable ivory nuts were examined with a view to ascertaining their suitability for use as substitutes for corosos nuts. The more interesting of these were as follows:—

Two samples of the nuts of the "Deleib" palm (*Borassus flabellifer*) from the Sudan were reported on. They were too soft and fibrous to be of value for button-making, and there seems no prospect of finding a market for them in Europe unless they can be shipped in a very much better condition. A sample of "dum" palm fruits from the East Africa Protectorate contained kernels of good quality, the endosperm in no case being less than ¼ inch in thickness. The kernels, however, weighed only 20 kilograms per 1,000, and would not be saleable in Italy, which is the chief market for these kernels at present. For that market kernels weighing less than 35 or 40 kilograms per 1,000 are unacceptable, and those weighing 45 to 50 kilograms per 1,000 are preferred.

A sample of rather small "dum" palm fruits and kernels from Northern Nigeria had an endosperm averaging about ¼ inch in thickness and very hard, white and translucent, but the kernels weighed only 16·7 kilograms per 1,000 and would not be saleable in Europe. The kernels of *Hyphaene crinita* from South Africa were also too small to be of commercial value. Ivory nuts from the Solomon Islands, derived from *Coelococcus salomonensis*, Warb., were also examined and valued.

Other miscellaneous products examined during the year included rum distilled in Sierra Leone; tea-seed cake from Hong Kong, which was found to contain 7 to 8 per cent. of saponin, and might be used for the preparation of vermicides for horticultural purposes; three samples of kelp from Ireland, and *Sonneratia acida* roots from Ceylon. The dried pulp of the seeds of the baobab tree from the East Africa Protectorate and a new variety of "manna" from Rhodesia were under examination at the close of the year.

Roots of *Mesembryanthemum Mahoni*, used in South Africa in place of yeast, were under investigation with a view to identifying the micro-organism which sets up the fermentation (*see* Report for 1911, p. 40).

A number of insect pests affecting tropical crops were received for identification, and suggestions were furnished as to remedial measures for dealing with them. They included locusts from Cyprus, crickets from Uganda and Sierra Leone, and various pests attacking sugar-cane in Mauritius.

General Enquiries.

The foregoing sections describing the work of the Scientific and Technical Department relate mainly to materials submitted for investigation through official channels, or samples forwarded by merchants for identification. In addition to this class of work a large number of enquiries of a commercial character, involving scientific and technical questions, are received each year. These enquiries are chiefly of two classes: (1) requests for advice from officials of technical departments in the Colonies and India as to the cultivation of new products, the commercial value of little known materials, or methods of marketing produce, and (2) requests from merchants and manufacturers, chiefly in the United Kingdom, for information as to new sources of raw materials, advice regarding the production of raw materials in the Colonies, &c.

The number of such enquiries in 1912 was 435, exclusive of those relating to settlement, emigration, and other similar matters, referred to elsewhere. A large proportion of these enquiries concerned food-grains, feeding materials, oil-seeds, oils, and tanning materials, whilst many enquiries relating to problems of tropical agriculture and forestry, such as the cultivation of rubber, cotton, tobacco, coffee, coconuts, oil palms, coarse fibres, &c., were also dealt with.

Numerous enquiries of a similar character were received regarding minerals.

VIII.—SUBSIDIARY WORK.

The twelfth, thirteenth, and fourteenth sessions of the African Tropical Service Course of instruction to candidates selected by the Colonial Office for administrative appointments in East and West Africa were held during the year. Instruction in the subject of Tropical Cultivation and Products was given by members of the staff of the Imperial Institute.

During the year meetings were held at the Imperial Institute by the African Society, the Anglo-Russian Literary Society, the British Women's Emigration Association, the Colonial Nursing Association, the Colonial and Continental Church Society, and the London Needlework Guild. Receptions of Colonial visitors were held at the Imperial Institute by the Victoria League on May 16, June 6, 20, and 27.

A lecture was given on May 15th, 1912, in the Jehanghier Hall, by Captain E. Nash, late R.A., of British Columbia, on "The Pacific Coast Fisheries and their Relation to Emigration and Imperial Naval Policy." Earl Grey presided.

At the request of the Colonial Office the Tropical Diseases Bureau has been provided with temporary office accommodation on the mezzanine floor until better accommodation can be provided.

A portion of the Upper West Gallery was lent to the City and Guilds of London Institute for the examination and display of the work executed by the candidates a the Institute's technological examinations throughout the Emp .

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
745	Trinidad and Tobago	1911–1912
746	British Guiana	1911–1912
747	St. Vincent	"
748	Barbados	"
749	Leeward Islands	"
750	Straits Settlements	"
751	East Africa Protectorate	1911
752	St. Lucia	1911–1912
753	Gilbert and Ellice Islands Protectorate	"
754	Cayman Islands (Jamaica)	1911
755	Gibraltar	1911–1912
756	St. Helena	1912
757	Weihaiwei	"
758	Ceylon	"
759	Sierra Leone	1911–1912
760	Seychelles	1912
761	Somaliland	"
762	Hong Kong	1912–1913
763	Turks and Caicos Islands	1912
764	Falkland Islands	"
765	Northern Territories of the Gold Coast	"
766	Bahamas	"
767	Gambia	1912–1913
768	Fiji	1912
769	Basutoland	"
770	Gold Coast	1912–1913
771	Ashanti	1912
772	Nyasaland	"
773	Bechuanaland Protectorate	1912–1913
774	British Solomon Islands	"
775	Colonial Survey Committee	"
776	Tongan Islands Protectorate	"
777	Swaziland	1911–1913
		1912–1913

MISCELLANEOUS.

No.	Colony, &c.	Subject.
77	St. Vincent	Roads and Land Settlement Fund.
78	Weihaiwei	Census, 1911.
79	Northern Nigeria	Mineral Survey, 1907–8 and 1908–9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments
85	Southern Nigeria	Mineral Survey, 1911.
86	Do.	Do. 1912.

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Gt. Brit. Colonial office

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No. 816.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE, 1913.

(For Report for 1912, see No. 778 [Cd. 7050-19] of 1913.)

Presented to both Houses of Parliament by Command of His Majesty.
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No. 816.

IMPERIAL INSTITUTE, 1913.

(For Report for 1912, see No. 778 [Cd. 7050-19] of 1913.)

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE IN 1913. BY PROFESSOR WYNDHAM R. DUNSTAN, C.M.G., M.A., LL.D., F.R.S., *Director*.

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I. PREFATORY STATEMENT.

THE IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA.

Trustees.

The First Commissioner of His Majesty's Treasury.
The Secretary of State for the Colonies.
The Secretary of State for India.
The President of the Board of Trade.

Advisory Committee, 1913.

(*Appointed under the provisions of the Imperial Institute Transfer Act*, 1902.)

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Sir Owen Philipps, K.C.M.G.
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Director.

Professor Wyndham R. Dunstan, C.M.G., M.A., LL.D., F.R.S.

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The Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May, 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire (i) by arranging comprehensive exhibitions of natural products, especially of the Dominions, Colonies, and India, and (ii) by providing for their investigation, and for the collection and dissemination of scientific, technical and commercial information relating to them.

The work of the Imperial Institute is at present carried on under four principal divisions: (1) the Colonial and Indian Collections, consisting mainly of raw materials and primary manufactures displayed in the public exhibition galleries, and including a Central Stand for receiving enquiries and distributing publications; (2) the Scientific and Technical Research Department, including a special staff, and research laboratories, occupying the second floor of the building and parts of the first floor and basement; (3) the Reference Library, containing a large collection of works of reference relating the Dominions, Colonies and India, together with the principal riodicals and newspapers; (4) the "Bulletin of the Imperial Institute," a quarterly publication containing a record of the work of the Imperial Institute in its various branches, as well as special articles on progress in tropical agriculture and industries and the commercial utilisation of the natural resources of the Dominions, the Colonies and India.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which His Royal Highness the Prince of Wales (afterwards King Edward VII.) was President, and an Executive Council, including representatives of the Indian Empire and of all the British Colonies and Dependencies. In 1900 the building became the property of His Majesty's Government, by whom the western portion of the main building and the galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portion of the main building being assigned, subject to rights of usage, for occupation by the University of London. In July, 1902, an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee, including representatives of the Dominions, Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A committee of management of three members, one nominated by each of the three Government departments chiefly concerned, was appointed, and at present consists of Mr. C. A. Harris, C.B., C.M.G., M.V.O., Sir Alfred Bateman, K.C.M.G., and Sir John P. Hewett, G.C.S.I., C.I.E.

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is

Professor Wyndham Dunstan, C.M.G., M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and the commercial utilisation of economic products.

The following are the principal departments of the Institute :—

Colonial and Indian Collections. The collections of economic products, etc., illustrative of the industrial and commercial resources of the Dominions, Colonies and India are arranged, together with other exhibits, on a geographical system in the public exhibition galleries of the Imperial Institute. The galleries are open free to the public daily (except Sundays, Good Friday, and Christmas Day) from 10 a.m. to 5 p.m. (from 10 a.m. to 4 p.m. in winter).

The following British Dominions, Colonies and Dependencies are represented by collections, which are in charge of technical superintendents :—

Canada, Newfoundland, Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahamas, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda, Falkland Islands, New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, Papua, New Zealand, Fiji, Western Pacific Islands, Union of South Africa, Rhodesia, Nyasaland, St. Helena, Gambia, Sierra Leone, Gold Coast, Nigeria, East Africa Protectorate, Zanzibar and Pemba, Uganda, Somaliland, the Anglo-Egyptian Sudan, Malta, Cyprus, Ceylon, Hong Kong, Mauritius, Seychelles, Straits Settlements, the Federated Malay States, and the Indian Empire.

Special arrangements are made to conduct parties from schools and institutions through the Colonial and Indian collections, for educational purposes.

A central stand for publications and an enquiry office have been opened in the main gallery to facilitate the supply of general information and the distribution of literature. Handbooks, pamphlets, circulars, etc., containing information relating to the commerce, agriculture, mining and other industries of the principal British Colonies, and also in regard to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, also may be obtained. Lists of publications available for distribution or sale are provided ; and the principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the departments in the main buildings.

The Scientific and Technical Research Department. The research laboratories and workrooms of this department were established in order to provide for the investigation of new or little-known natural products from the Dominions, the Colonies and India and of known products from new sources, with a view to their utilisation in commerce. The Department also furnishes trustworthy scientific and technical advice on matters connected with the agriculture, trade and industries of the countries of the British Empire.

The work of this department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements also have been made by the Foreign Office, whereby British representatives abroad may transmit to the department, for investigation, such natural products of the countries to which they are appointed as are likely to be of interest to British manufacturers and merchants.

Materials investigated in the research laboratories of the department are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

A reference sample room is maintained in this department, in which are arranged samples of the principal materials which have been investigated and valued commercially during recent years, and as to which full information is available.

The Department works in co-operation with the Agricultural, Mines and other Departments in the Colonies, whose operations it supplements by undertaking investigations and enquiries of a special scientific or technical character connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial valuation of products (animal, vegetable or mineral) which can be more efficiently conducted at home in consultation with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which has been printed in a volume of *Technical Reports and Scientific Papers*, published in 1903. A series of selected reports is now being issued in the Miscellaneous Series of Colonial Reports. Of these selected reports, five parts have been published: Part I., "Fibres" (Cd.4588); Part II., "Gums and Resins" (Cd.4971); Part III., "Foodstuffs" (Cd.5137); Part IV., "Rubber and Gutta Percha" (Cd.6022); Part V., "Oilseeds, Oils, Fats and Waxes" (Cd.7260).

Mineral Surveys, under the supervision of the Director of the Imperial Institute, and conducted by surveyors selected by him, are in progress in several countries. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained.

Reports by the Director on the results of mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

Tropical African Services Course. A course of instruction in certain specified subjects is given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction in this course in the subject of tropical economic products is given by Dr. S. E. Chandler, of the staff of the Imperial Institute.

Library and Reading Rooms. The library and reading rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference and are regularly supplied with the more important official publications, and with many of the principal newspapers and technical and other periodicals of the United Kingdom, the Dominions, the Colonies, India, and foreign countries.

The library and reading rooms are on the first floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute and of other accredited persons. Books and newspapers may be consulted for special purposes, by permission.

The map room in the library contains a representative collection of recent maps of India, the Dominions, the Colonies, etc., which may be consulted on application to the Officer in Charge.

Colonial Conference Rooms. Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Dominions and Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall. The Bhownaggree corridor and rooms in connection with the Cowasjee Jehanghier Hall are in the occupation of the Indian section of the Imperial Institute. The hall is available for lectures, meetings, etc.

The "Bulletin of the Imperial Institute" is published quarterly by Mr. John Murray, 50a, Albemarle Street, London, price 2*s.* 6*d.*, post free 2*s.* 9*d.* (annual subscription 11*s.*, including postage), and may be purchased through any bookseller, or from Agents in the Dominions, the Colonies, India, and foreign countries. The Bulletin contains records of the principal investigations carried out at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (animal, vegetable and mineral).

Imperial Institute Series of Handbooks to the Commercial Resources of the Tropics. The Secretary of State for the Colonies has authorised the preparation of a series of handbooks dealing with the Commercial Resources of the Tropics, with special reference to West Africa. The handbooks are edited by the Director of the Imperial Institute, and published by Mr. John Murray. The first three volumes are: "The Agricultural and Forest Products of British West Africa," by Gerald C. Dudgeon, Consulting Agriculturist, Ministry of Agriculture, Egypt, and lately Inspector of Agriculture for British West Africa, price 5*s.* net: "Cocoa: Its Cultivation and Preparation," by W. H. Johnson, F.L.S., Director of Agriculture, Southern Provinces, Nigeria, price 5*s.* net; and "Rubber: Its Sources, Cultivation and Preparation," by Harold Brown, Technical Superintendent, Scientific and Technical Department, Imperial Institute, price 6*s.* net.

The following societies have their offices at the Imperial Institute:—

International Association for Tropical Agriculture, British Section. The object of this Association, the central bureau of which is in Pa is, is to promote the scientific and practical study of all questions connected with tropical agriculture, including the development and utilisation of the natural resources, of tropical countries. The British Section has its headquarters at the Imperial Institute. Members of the British Section are permitted to use the library and reading rooms of the Imperial Institute, and a writing room also has been provided for their use.

British Women's Emigration Association. The British Women's Emigration Association has been assigned offices on the mezzanine floor, which are open daily from 10 a.m. to 4 p.m. Advice and information respecting emigration and prospects for women in the Dominions may be obtained there free of charge. The Association works in co-operation with the Emigrants' Information Office in Westminster.

Colonial Nursing Association. An office on the mezzanine floor of the Imperial Institute has been allotted to this Association, the principal object of which is the selection of trained hospital and private nurses for service in the Crown Colonies and Dependencies.

Tropical Diseases Bureau. Temporary office accommodation on the mezzanine floor has been provided for this bureau, the main purpose of which is to collect information regarding tropical diseases and to distribute it as widely as possible among those who are engaged in combating such diseases.

Universities Bureau of the British Empire. An office on the mezzanine floor has been allotted to this bureau, the object of which is the collection and dissemination of information relating to the Universities of the British Empire.

II. GENERAL.

The present report relates to the work which has been carried out in the several Departments of the Imperial Institute during the year 1913, and is in continuation of previous reports. (Report for 1906 and 1907, Cd.3729–48; Report for 1908, Cd.4448–10; Report for 1909, Cd.4964–30; Report for 1910, Cd.5467–23; Report for 1911, Cd.6007–37; Report for 1912, Cd.7050–19.)

III. STAFF.

During the year 1913 the principal members of the staff were as follows:—

Director of the Imperial Institute:—

Wyndham R. Dunstan, C.M.G., M.A., LL.D., F.R.S.

Assistant Secretaries to the Director:—

G. A. I. Bosanquet, B.A. (Cantab.).
The Hon. T. L. McClintock Bunbury, M.A. (Cantab.).

SCIENTIFIC AND TECHNICAL DEPARTMENT.

Superintendent of Laboratories:—

T. A. Henry, D.Sc. (Lond.), F.C.S.

Technical Superintendent :—
Harold Brown.

Assistant Superintendents :—
E. Goulding, D.Sc. (Lond.), F.C.S.
T. Crook, A.R.C.Sc., F.G.S.

Special Assistants :—
H. H. Robinson, M.A. (Oxon.), F.C.S.
J. W. Evans, D.Sc. (Lond.), F.G.S. (until October,1913).
B. E. Long, B.A. (Cantab.).
H. J. Jeffery, A.R.C.Sc., F.L.S.

Senior Assistants :—
A. E. Andrews, F.C.S.
S. J. Johnstone, B.Sc. (Lond.).
R. G. Pelly, F.I.C.
R. Gaunt, Ph.D. (Berlin), F.C.S.
J. R. Furlong, Ph.D. (Würzburg).

Assistants :—
W. O. R. Wynn.
G. M. Davies, B.Sc. (Lond.), F.G.S.
O. D. Roberts, A.I.C.
J. Shelton, F.I.C.
B. W. Whitfeild.
G. T. Bray.
H. W. Winter.
J. C. Earl, A.I.C. (until November, 1913).
L. E. Campbell, B.Sc. (Lond.), A.I.C. (until April, 1913).
G. L. Matthews, B.Sc. (Lond.).
J. Young.
T. McLachlan.
J. D. F. West.

The special officers of the Mineral Surveys of Ceylon, Southern Nigeria, Mozambique, and Gwalior (Central India), in progress in connection with the Imperial Institute, were :—

Ceylon :—
J. S. Coates, B.A. (Cantab.)
E. J. Wayland, F.G.S.

Southern Nigeria :—
A. D. Lumb, A.R.S.M., F.G.S.
M. Whitworth, A.R.S.M.

Mozambique Company's Territory :—
E. O. Thiele, M.Sc. (Melbourne), F.G.S.
R. C. Wilson, B.Sc. (Melbourne), F.G.S.

State of Gwalior, Central India :—
Douglas R. Home, F.G.S.
S. M. Owen, A.R.S.M., F.G.S.
E. J. Parsons, B Sc., F.G.S.

EXHIBITION GALLERIES :—COLONIAL AND INDIAN COLLECTIONS.

Technical Superintendents :—
S. E. Chandler, D.Sc. (Lond.), F.L.S.
H. Spooner.
A. B. Jackson.

Assistant Technical Superintendents :—
F. W. Rolfe.
D. J. Taylor.

TROPICAL AFRICAN SERVICES COURSE.

Instructor in Tropical Cultivation and Products :—
S. E. Chandler, D.Sc. (Lond.) F.L.S. (From April, 1913).

The following members of the Staff resigned their appointments during 1913 to take up the positions indicated :—

Dr. J. W. Evans, D.Sc. (Lond), F.L.S., was appointed Lecturer in Petrology at the Imperial College of Science and Technology.

Mr. L. E. Campbell, B.Sc. (Lond.), A.I.C., was appointed Chemist to the Rubber Research Committee in Ceylon.

IV. PUBLIC EXHIBITION GALLERIES.

The principal aim of the Colonial and Indian Collections in the Public Exhibition Galleries is to illustrate by means of exhibits, chiefly consisting of raw products and primary manufactures, the commercial and industrial resources of the various parts of the British Empire, and by these and other exhibits to present a view of their general position and resources.

By the provision of specially prepared descriptive labels for the exhibits much has been done to render them more attractive to visitors and to a large extent self-explanatory. Additional information is supplied when required by the Technical Superintendents, whose offices are adjacent to the galleries. Parties of visitors, including parties from schools, may, by arrangement, be accompanied through the galleries by the Superintendents, who explain the important features of the exhibits. The London County Council has shown special interest in the last-mentioned arrangement, and recognises its value in relation to the teaching of the commercial geography of the British Empire by making special arrangements for schools in and near London to visit the galleries.

An increase has taken place in the number of parties from schools which have visited the Exhibition Galleries.

Improvements and extensions of the Courts of the Sudan, Mauritius, Cyprus and British Guiana have been made during the year.

The new Court of Newfoundland in the North Gallery was opened to the public.

The reconstruction of the bridge in the Canadian Section was completed by H.M. Office of Works and the new structure forms a satisfactory connection between the West and North Galleries. The whole of the North Gallery is now occupied by permanent Collections.

Progress was made with the re-arrangement of the British Malaya Court and with the internal decoration of the new Ceylon Pavilion.

Additional exhibits, comprising economic products, photographs, maps, etc., were received for the Courts of the following countries of the Empire :—Canada, Ceylon, Cyprus, the East Africa Protectorate, the Falkland Islands, Fiji, the Gold Coast, India, Leeward Islands, Mauritius, New South Wales, New Zealand, Northern Nigeria, Nyasaland, Papua, Queensland, Sierra Leone, Southern Nigeria, the Straits Settlements and Federated Malay States, Sudan, Uganda, Victoria, the Virgin Islands and Western Australia.

New show cases were added to the British Honduras, Nyasaland, Straits Settlements, Federated Malay States, and Northern Nigeria Courts.

The Reference Collection in the Upper East Gallery of the principal standard commercial raw products of the world has proved of great interest to visitors, and has facilitated the comparison of new products received from the Colonies with those of established commercial and industrial value.

Specimens of Colonial and Indian products have been supplied to a number of schools to assist in the formation of school museums and in the teaching of the commercial geography of the British Empire.

Several of the Crown Colonies have arranged to maintain at the Imperial Institute reserve collections to illustrate their resources and industries. The reserve collections are arranged by the staff of the Imperial Institute and lent to temporary exhibitions in this country at which these Colonies desire to be represented.

Specimens of products of Nyasaland, Zanzibar and Uganda were lent for the David Livingstone Centenary Exhibition at Edinburgh. Collections of exhibits from Dominica, Antigua, St. Lucia, Grenada and British Guiana were lent for the exhibition at the Royal Agricultural Show at Bristol. A collection of exhibits from East Africa, Mauritius, the West Indies, and India was lent for the purposes of a " Britain-over-the-Seas " Exhibition held at Croydon. A collection of specimens of products was supplied for the Art Gallery, Rochdale.

The number of ordinary visitors to the Exhibition Galleries during 1913 was 214,900, as against 205,503 during 1912.

The number of publications relating to the Dominions, Colonies and India distributed to enquirers at the Central Stand in 1913 was 19,910, as against 17,595 distributed in 1912.

V. LIBRARY AND READING ROOMS.

The additions to the library during the year 1913 numbered 2,267 volumes and pamphlets, whilst the number of newspapers and periodicals received was 29,869.

Besides its constant use by members of the staff, the library has been used by Life Fellows of the Imperial Institute, and also by

enquirers for special information, the number of whom in 1913 was 853. The facilities afforded by the library have been utilised during the year by a number of officers of the Colonies and Protectorates and of India at home on leave, who have also been given assistance in pursuing special enquiries.

VI. PUBLICATIONS.

Bulletin of the Imperial Institute.

The "Bulletin of the Imperial Institute," which in 1912 was greatly enlarged, and its publication transferred to Mr. John Murray, is one of the principal means available for making known the results of the investigations conducted at the Imperial Institute and for disseminating the knowledge thus gained in its application to the development of the resources of the Empire and to progress in tropical agriculture.

It is satisfactory to record that the circulation of the Bulletin tends steadily to increase, whilst the extent to which its contents are constantly quoted by other newspapers and periodicals is evidence of the estimation in which it is held as the authoritative source of information on the subjects with which it deals.

Up to the middle of 1912 the Bulletin was prepared entirely by the Scientific and Technical Staff of the Imperial Institute, but in that year a section of the Bulletin was opened to external contributors, and this was continued in 1913, when seven special articles were contributed by well-known British and Foreign authorities in their respective subjects.

The following are the titles of the reports and articles which have appeared in the quarterly numbers of the "Bulletin of the Imperial Institute," Vol. XI, 1913:—

Reports of Investigations conducted at the Imperial Institute:—

Tobaccos from Portuguese East Africa.
Tobacco from Papua.
The Utilisation of Sudan Dura.
Camphor Oil and Crude Camphor from the Federated Malay States.
Oil of *Eucalyptus citriodora* from Mauritius.
Marjoram Oil from Cyprus.
Beeswax from the Anglo-Egyptian Sudan.
Oil Seeds from the Anglo-Egyptian Sudan.
"Cheyi" Seed and Fibre.
Zapupe Fibre.
"Cabbage Tree" Fibre from New Zealand.
"Elephant Grass" as a Paper-Making Material.
The Cotton Industry of Northern Nigeria.
Some Flosses or Silk-Cottons.
M'Zimbiti Timber from Mozambique.
Timber of *Triplochiton Johnsonii.*
Crude Petroleum from Morocco.
Petrol from Tasmania.

Crude Petroleum from Nova Scotia.
Recent Progress in Cotton Cultivation in the Sudan.
Jute from the Sudan.
The Fibre of *Calotropis procera*.
The African Palm Oil Industry.—II.
Copals from Mozambique.
Cohune Nuts from British Honduras.
Some New or Little-known Leguminous Feeding-Stuffs.
Minerals from the Federated Malay States.
Iron Ore from Ceylon.
Argentiferous Lead Ore from Southern Nigeria.
The Salt Industry of Turks and Caicos Islands.
The Quality of Para Rubber from Various Sources.
Ceara Rubber from Northern Nigeria.
The Cotton Industry of Uganda.
New Colonial and Other Tanning Materials.
Essential Oils from Various Countries.
" Gorli " Seed from Sierra Leone.
The Utilisation of Para Rubber Seed.—II.
Some New or Little-known Oil Seeds and Oils.
Ground Nuts.
Baobab Fruits and Seeds from the East Africa Protectorate.
Tobaccos from the East Africa Protectorate.
Cotton Growing in the Gold Coast.

Special Articles :—

The Progress of Egyptian Agriculture, with Special Reference to Cotton. By Gerald C. Dudgeon, F.E.S., Consulting Agriculturist, Ministry of Agriculture, Egypt, Vice-President of the International Association for Tropical Agriculture.

The Agriculture of Mozambique Province, Portuguese East Africa. By R. N. Lyne, F.L.S., Director of Agriculture, Ceylon ; lately Director of Agriculture in the Province of Mozambique.

The Pottery Industry of Ilorin, Northern Nigeria. (Illustrated.) By Dr. J. W. Scott Macfie, Medical Officer, Ilorin, Northern Nigeria.

The " Wood-Oil " Trees of China and Japan. (Illustrated.) By Ernest H. Wilson, Arnold Arboretum, Harvard University, U.S.A.

The Organisation of Experimental Work in Agriculture in the German Colonies. By Dr. Walter Busse, Imperial German Colonial Office, Berlin.

The Canadian Department of Agriculture. By J. H. Grisdale, B.Agr., Director, Dominion Experimental Farms, Ottawa

Agriculture in Hausaland, Northern Nigeria. By P. H. Lamb, Director of Agriculture, Northern Nigeria.

Special Report :—

Tea : Its Cultivation, Manufacture, and Commerce. (Illustrated.) Lectures by S. E. Chandler, D.Sc., F.L.S., and John McEwan, F.R.G.S.

General Notices Respecting Economic Products and their Development.

Some Common Spices.
Manufacture of Paper Pulp for Export.
Notes on the Cultivation and Preparation of Turkish Tobacco
The Occurrence, Distribution and Uses of Mercury.
The Coals of Canada.
The Cultivation and Preparation of Rice.—Part I.
Cotton Cultivation in Northern Nigeria.
The Conversion of Liquid Oils into Solid Fats.

General Notes :—

Sisal Hemp Cultivation in German East Africa.
Recent Developments in Cotton Growing in the United States.
Cocoa from Southern Nigeria.
The Agricultural Possibilities of the Panama Canal Zone.
Mineral Output of New South Wales.
Mineral Output of Queensland.
The Utilisation of Zirconium Minerals.
Ash of *Cyperus Haspan.*
A Tropical Agricultural College.
The Volatile Oil of *Alpinia alba* Fruits.
A New Variety of "Manna" from Rhodesia.
Scarlet-Runner Roots.
Sisal Hemp Industry of Fiji.
Plants Protection Ordinance in Nyasaland.
Native Produce in the Sokode-Bassari District of Togoland.
Geology in Egypt.
Mineral Production of Ontario.
Mineral Production of Western Australia.
Cotton Protection Ordinance in Nyasaland.
Cotton Growing in French Colonies.
Balanites spp. from Portuguese East Africa.
Mineral Survey of Mozambique.
Oil Possibilities in South Australia.
Mineral Production of Quebec.
Dredging in the Sudan.
Report on the Work of the Imperial Institute, 1912.
Mineral Survey of Southern Nigeria.
South Africa and the Diamond-Cutting Industry.
Mineral Production of the Union of South Africa.
Mineral Production of British Columbia.
The Grading of South African Maize, Kaffir Corn, and Jiba.
Cotton Growing in the Ivory Coast.
Cotton Protection Rules in Uganda.
Certificates of Freedom from Plant Pests.
The Agricultural Department of the Belgian Congo.
The Agriculture of Abyssinia.

Recent Progress in Agriculture and the Development of Natural Resources :—

Soils and Manures, Foodstuffs, Oils and Oil Seeds, Essential Oils, Rubber, Fibres (including Cotton), Tobacco, Forestry and Forest Products, Economic Minerals.

Notices of Recent Literature :—

New Books.

Other Publications.

During 1913 the following official publications relating to the work of the Imperial Institute were issued :–

Report on the Results of the Mineral Survey of Southern Nigeria, 1911, by Professor Dunstan. (Colonial Reports—Miscellaneous, No. 85, Cd 7067).

Report on the Results of the Mineral Survey of Southern Nigeria, 1912, by Professor Dunstan. (Colonial Reports—Miscellaneous, No. 86, Cd. 7110).

Annual Report on the Work of the Imperial Institute, 1912. (Colonial Reports—Annual, No. 778, Cd. 7050–19).

The following is a list of scientific and technical books and papers published during the year by members of the Staff of the Imperial Institute :—

"Vegeto-Alkaloids." By Professor Wyndham R. Dunstan and Dr. T. A. Henry (Thorpe's Dictionary of Applied Chemistry, 1913, Vol. 5, p. 627).

"The Plant Alkaloids." By Dr. T. A. Henry (London : J. and A. Churchill).

"Note on the fat of the seeds of *Oncoba echinata* ; occurrence of chaulmoogric acid." By Dr. E. Goulding and N. C. Akers (Proceedings of the Chemical Society, 1913, Vol. 29, p. 197).

"Silk." By Dr. E. Goulding (Thorpe's Dictionary of Applied Chemistry, 1913, Vol. 4, p. 682).

"Wool." By Dr. E. Goulding (Thorpe's Dictionary of Applied Chemistry, 1913, Vol. 5, p. 788).

"The Systematic Examination of Loose Detrital Sediments." By T. Crook (Appendix to Hatch and Rastall's "Petrology of the Sedimentary Rocks." George Allen and Co., London, 1913).

"Septaria : a Defence of the Shrinkage View." By T. Crook (Geological Magazine, 1913, Vol. 10, p. 514).

"Animal and Vegetable Waxes." By H. H. Robinson (Thorpe's Dictionary of Applied Chemistry, 1913, Vol. 5, p. 736).

"The Wearing Down of the Rocks." By Dr. J. W. Evans. Presidential Address to the Geologists' Association (Proceedings of the Geologists' Association, 1913, Vol. 24, p. 241).

"Directions for the Collection of Geological Specimens." By Dr. J. W. Evans (Miscellaneous Publication No. 283, Colonial Office, 1913).

"Die Geometrie der Zwillingskrystallen." By Dr. J. W. Evans (Zeitschrift für Krystallographie, 1913, Vol. 52, p. 327).

"Titanium and its Uses." By S. J. Johnstone. (Chemical World, 1913, Vol. 2, p. 283).

"Composition of the Fruit and Seeds of *Adansonia digitata*." By R. G. Pelly (Journal of the Society of Chemical Industry, 1913, Vol. 32, p. 778).

"Volatile Oil of *Alpinia alba* fruits." By Dr. S. S. Pickles and J. C. Earl (Proceedings of the Chemical Society, 1913, Vol. 29, p. 164).

"A new variety of Manna and a Note on the Melting Point of Dulcitol." By Dr. J. R. Furlong and L. E. Campbell (Proceedings of the Chemical Society, 1913, Vol. 29, p. 128).

VII. SCIENTIFIC AND TECHNICAL DEPARTMENT.

An account is given in the succeeding pages of the work carried on in this Department during the year, partly in conducting scientific, technical and commercial investigations as to the composition and value of raw materials—animal, vegetable and mineral—and partly in supplying information respecting the value and utilisation of such materials, and their cultivation or production. The number of reports completed in 1913 was 460, and at the end of the year 124 investigations were in progress. Details respecting these investigations are given under the heading of the subject to which they relate. Countries for which investigations have been conducted are:— Commonwealth of Australia, Bahamas, Barbados, Bermuda, British Guiana, British Honduras, Brunei, Canada, Ceylon, Cyprus, Dominica, East Africa Protectorate, Falkland Islands, Federated Malay States, Fiji Islands, Gambia, Gold Coast, Grenada, Hong Kong, India, Jamaica, Malta, Mauritius, Montserrat, Newfoundland, New Zealand, Nigeria, Nyasaland, Papua, Rhodesia, St. Helena, St. Vincent, Sarawak, Seychelles, Sierra Leone, Solomon Islands, Somaliland, Straits Settlements, Sudan, Trinidad and Tobago, Turks and Caicos Islands, Uganda, Union of South Africa, Virgin Islands, Weihaiwei, Zanzibar and Pemba. A large number of enquiries from commercial firms in the United Kingdom were also dealt with, which involved the collection of a very considerable amount of special information. The work of collecting and collating this information, for which there is an increasing demand on the part of British manufacturers and merchants, is severely taxing the ordinary staff of investigators attached to the Department, and has now attained dimensions which require that this work should be dealt with by a separate staff constituting a Technical Information Bureau which it is hoped may be inaugurated during 1914 (*see* page 45).

Minerals.

Countries of origin:—Malta, Sudan, Somaliland, East Africa Protectorate, Uganda, Nyasaland, Union of South Africa, Gambia, Sierra Leone, Nigeria, India, Ceylon, Federated Malay States, Hong Kong, Commonwealth of Australia, New Zealand, Canada, Newfoundland, West Indies, British Guiana, Falkland Islands, Foreign Countries.

Mineral Surveys were continued during the year in the Southern Provinces, Nigeria, the State of Gwalior (Central India), Ceylon, and in the Territory of the Mozambique Company, Portuguese East Africa, and a large number of mineral specimens collected in these countries were examined and reported on.

Malta.—A memorandum on the geology of Malta, with special reference to the possible occurrence of petroleum in the island, was furnished to the Colonial Office.

Somaliland.—Two samples of bituminous earth, one of water containing bitumen, and one of oil-bearing sand, were examined and reported on. The last-named material furnished only a small proportion of oil on distillation, but the occurrence is of considerable importance as a possible indication of the presence of petroleum, as such, in the strata below the surface. A memorandum on the geology of Somaliland in relation to the possible occurrence of mineral oil in that country was supplied to the Colonial Office.

East Africa Protectorate.—Three samples of graphite-bearing rock and one of dolomite were examined.

Uganda.—A specimen of asbestos of the amphibole variety was reported on. It was a weathered sample of little or no value, but the occurrence is worth further examination in order to ascertain its extent and the nature of the fresh material.

Nyasaland.—A specimen of coal from Portuguese East Africa was received from the Nyasaland Government. It was obtained from a deposit which is believed to extend into British territory, and although it proved to be of rather low value as fuel the occurrence is sufficiently promising to warrant full investigation.

A sample of ilmenite containing a small admixture of rutile was examined and a specimen of dolomitic material was under examination at the close of the year.

Union of South Africa.—The minerals reported on included three specimens of columbite containing respectively 21·96, 28·10 and 30·89 per cent. of tantalic oxide; asbestos of the anthophyllite variety, muscovite mica, and beryl.

Gambia.—A yellow clay, possibly suitable for local use in the manufacture of coarse earthenware, and a purple clay which might be used locally for making bricks and tiles, were examined and reported on.

Nigeria.—A specimen of "kankar" from the Northern Provinces consisted of concretions of calcium carbonate containing a considerable amount of silica in the form of sand and grit. The material would be suitable for use locally as a dressing for soils deficient in lime.

In addition to the specimens collected by the Mineral Survey a number of other minerals from the Southern Provinces were examined and reported on. These included 34 specimens of borings from wells sunk in the course of a search for petroleum, 10 samples of silver-lead ores, 5 of which ranged in value from £15 2*s.* to £20 13*s.* per ton according to the amounts of lead and silver present, and two specimens of impure zinc blende.

The materials under examination at the close of the year included kaolin and lead ore from the Southern Provinces and a series of native salts from the Northern Provinces.

Federated Malay States.—The technical examination of the cerussite referred to in the Report for 1912 (p. 20) was completed. The concentrate contained approximately 42 per cent. of lead and 11 per cent. of tin, and was valued at £12 10*s.* per ton delivered Bristol (February, 1913).

Commonwealth of Australia.—The examination of the following minerals from Tasmania was completed during the year:—Four samples of limestones, an oil-shale, and specimens of kaolin and mica.

Information was furnished to the Government of South Australia as to the possibility of marketing the uranium ores recently discovered in the State.

A specimen of crude petroleum from the Vailala oil field in Papua was reported on. It proved to be of a particularly valuable type owing to the high proportion of light petroleum and kerosene it contained and the purity of the fractions yielded on distillation.

At the close of the year, iridosmium from Tasmania and three samples of radio-active ores from South Australia were under examination.

West Indies.—A sample of salt from Turks and Caicos Islands consisted of clean crystalline salt of a high degree of purity and similar to samples previously examined at the Imperial Institute (see "Bulletin of the Imperial Institute," Vol. XI (1913), p. 250).

British Guiana.—A sample of earthy lignite was examined. It contained a large amount of moisture and undesirably high percentages of sulphur and ash, and such material would be of rather low value as a fuel.

United Kingdom.—Amongst the minerals received from firms and individuals in this country for identification were a plastic clay, nodular sulphide of iron and corundum.

Foreign Countries.—A number of specimens forwarded by British Consular Officers in foreign countries were examined and reported on. A specimen of "sulphur" earth sent by the British Vice-Consul at Jaffa, Turkey-in-Asia, consisted of sand containing a quantity of gypsum and 1·75 per cent. of free sulphur. A sample of crude petroleum obtained from near Mazaria, Morocco, was forwarded by H.M. Consul at Fez. It proved to be similar to a sample from this locality previously examined at the Imperial Institute (see "Bulletin of the Imperial Institute," Vol. XI (1913), p. 86). Ten samples of minerals sent by the British Vice-Consul at Broussa, Turkey-in-Asia, and 12 minerals from Central Madagascar forwarded by H.M. Consul at Antananarivo were under examination at the close of the year.

Soils.

Countries of origin:—East Africa Protectorate, Uganda, Nyasaland, Nigeria.

Seven soils from the East Africa Protectorate, six from the Botanic Gardens, Entebbe, Uganda, and one of typical Kano soil from Nigeria,

were examined and reported on, and recommendations were made as to the crops which would be suitable for each soil. At the close of the year 25 soils from the East Africa Protectorate, 35 from Nyasaland, and 7 from Nigeria were under examination.

MANURES.

Countries of origin:—Zanzibar, Nyasaland, India, Straits Settlements, Falkland Islands.

Two samples of cotton seed from Nyasaland were examined in order to determine their relative manurial value. One of them, which had been exposed in the open for a year, showed a considerable loss of potash, phosphoric acid and nitrogen, as compared with the other sample, which represented seed as received from the ginnery.

In connection with an investigation into the fish oil industry of Madras, three samples of so-called "fish guano" or fish meal were examined. Judging from the results of analyses these products should be readily saleable either as manure or for the preparation of fish-meal feeding stuffs for cattle. They contained normal amounts of nitrogen, fat, and phosphates, but were not quite so rich in proteins as commercial samples of fish meals.

Five samples of penguin guano from the Falkland Islands were under examination at the close of the year.

FIBRES (INCLUDING COTTON).

Countries of Origin:—Cyprus, Sudan, East Africa Protectorate, Uganda, Zanzibar, Nyasaland, Rhodesia, Union of South Africa, Sierra Leone, Gold Coast, Nigeria, St. Helena, Mauritius, India, Ceylon, Federated Malay States, Weihaiwei, Sarawak, Commonwealth of Australia, New Zealand, Fiji Islands, Solomon Islands, Canada, Newfoundland, West Indies, United Kingdom, Foreign Countries.

Cotton.

Sudan.—Two samples of Improved American Upland cottons were rather irregular in length, but otherwise were of good quality and worth 7·75*d.* and 7·10*d.* per lb., respectively, with "good middling" American at 6·95*d.* per lb. A sample of seed-cotton of an Improved American Upland variety which had been grown as a rain crop in Southern Kordofan was also examined. The lint was of fair quality on the whole and was valued at 7·30*d.* per lb., with "middling" American at 6·70*d.* per lb., but its value was diminished by its irregular and rather poor strength as well as by the presence of stains.

Two samples of Mitafifi cotton were valued at 9·25*d.* and 9·75*d.* per lb., respectively, with "fully good fair" brown Egyptian at 9·55*d.* per lb. They were rather irregular in length and strength, and the value of the first sample was also reduced by its uneven colour and the presence of stains.

Fifty-one samples of cotton from the Sudan were under examination at the end of the year.

Uganda.—Three samples of seed-cotton grown at the Government Experimental Farm, Kadungoro, and three samples grown by natives

in different districts of the Eastern Province were examined. The former when ginned were valued at 8·25*d*., 7·75*d*. and 7·40*d*. per lb., respectively, and the latter at 7·25*d*., 6·40*d*. and 6·15*d*. per lb., with middling American at 6·85*d*. and "fully good fair" Abassi at 10·45*d*. per lb. All the cottons were of good appearance, but somewhat irregular in staple, containing an appreciable quantity of weak, immature fibre.

Nyasaland.—Two samples of Nyasaland Upland cotton which won the 1st and 2nd prizes at the Blantyre Show in 1912 proved to be of excellent quality, and were valued at 9·50*d*. per lb., with "good fair" brown Egyptian at 9·80*d*. and "fully good fair" Abassi at 10·30*d*. A sample of selected Nyasaland Upland cotton grown at the Government farm was of good quality, but inferior to the foregoing, and was valued at 9·00*d*. per lb. on the same date.

Sierra Leone.—A sample of Cambodia seed-cotton and one of Sea Island seed-cotton were examined and reported on. The lint of the former was valued at 7·50*d*. per lb., with "middling" American at 6·57*d*. per lb., whilst that of the latter was of excellent quality, and was valued at 16*d*. to 17*d*. per lb., with "fine" Sea Island cotton at 16*d*. and "extra fine" at 19*d*. per lb., its value being somewhat reduced by the presence of some weak, immature fibre.

Gold Coast.—A series of nine samples of Improved American Upland and native cottons was examined. Most of them, and especially the exotic varieties, showed considerable irregularity in length and in strength, and all except two were regarded by commercial experts as being too short to compete with American cotton. Their value ranged from 6¼*d*. to 7½*d*. per lb., with "middling" American at 7*d*. per lb. A further sample of seed-cotton of a native variety was also reported on. The lint was rather coarse and harsh, but of promising quality, and it could possibly be improved by systematic cultivation. It was valued at ½*d*. to 1*d*. per lb. in advance of "middling" American, which at the date of the report was quoted at 6·79*d*. per lb. Herbarium specimens of the plant yielding this cotton were identified at the Royal Botanic Gardens, Kew, as *Gossypium arboreum*, Linn.

Nigeria.—A sample of indigenous seed-cotton (*Gossypium peruvianum*) and one of Improved American Upland cotton from the Northern Provinces were reported on. The lint of the former was valued at 6·00*d*. per lb. and that of the latter at 9*d*. per lb., with "middling" American at 6·60*d*. and "fully good fair" Abassi at 10¼*d*. per lb. Herbarium specimens of three indigenous cottons from the Northern Provinces were also reported on.

India.—A series of 52 samples of ginned and unginned cottons of native varieties and locally produced hybrids grown at Bellary, Madras, was reported on. They were all similar in character and on the whole of satisfactory quality. Their value ranged from 5¾*d*. to 6¾*d*. per lb., but mostly from 6¼*d*. to 6½*d*. per lb., with "fine" Broach at $6\frac{9}{16}d$., "good" Comptah at $6\frac{3}{16}d$., and "middling" American at 6·80*d*. per lb.

Nine samples of seed-cotton from Sind were reported on. They were

all of satisfactory quality and would be readily saleable. A sample of Mitafifi was valued at 8·50*d.* per lb. ginned, with "fully good fair" brown Egyptian at 10·05*d.*, one of Sindhi cotton was valued at 6·00*d.* per lb. with "fine" machine-ginned Bengals at $5\frac{3}{8}d.$, while the value of the remaining seven samples, which were of Improved American Upland varieties, ranged from 7·10*d.* to 8·20*d.* per lb., with "middling" American at 6·96*d.* and "fully good middling" American at 7·25*d.* per lb.

Twenty samples of Dharwar American cotton grown at the Lyallpur Experimental Farm, Punjab, were found to be of fair quality and represented cottons which would be saleable in the United Kingdom. Their values ranged from $5\frac{7}{8}d.$ to $6\frac{3}{4}d.$ per lb., with "good" Tinnevelly at $6\frac{1}{16}d.$, "fine" Broach at $6\frac{1}{4}d.$, and "middling" American at 6·69*d.* per lb. Specimens of Indian and American cottons from the Punjab, stated to be ordinary farmers' samples, proved to be of poor quality, and were valued at $5\frac{1}{4}d.$ and $5\frac{3}{4}d.$ to $5\frac{7}{8}d.$ per lb., respectively, on the same date as the preceding set of samples. Eight samples of seed-cotton grown at the Lyallpur Experimental Farm were very similar to one another. The lint was of satisfactory appearance and strength and was valued at $5\frac{1}{4}d.$ to 6*d.* per lb., with "fine" Bengals at $5\frac{9}{16}d.$ per lb. If a little longer and less rough the cottons would have been worth $\frac{1}{2}d.$ per lb. more.

Ten samples of seed-cotton produced in the course of selection experiments were reported on. They were all of good clean staple and represented a very satisfactory growth. The ginned cottons were valued nominally at prices ranging from $5\frac{7}{8}d.$ to $6\frac{1}{4}d.$ per lb., with "middling" American at 6·81*d.*, "fine" Broach at $6\frac{5}{8}d.$ and "fine" Bengals at $5\frac{3}{4}d.$ per lb.

Four samples of Cambodia seed-cotton from Burma were examined. Two of them were of fairly good quality, but lacking in strength, and were valued respectively at 7*d.* and $6\frac{3}{4}d.$ per lb. ginned, with "middling" American at 6·57*d.* per lb.; and the others were of poor quality on the whole and were valued respectively at $6\frac{1}{4}d.$ and $5\frac{1}{2}d.$ per lb. ginned. Four samples of native seed-cotton from Burma proved to be too short in staple for use in the United Kingdom. The lint in one case was reddish-brown in colour and was valued nominally at 5*d.* per lb.; in the other cases the value of the lint varied from $5\frac{1}{4}d.$ to $5\frac{3}{4}d.$ per lb., with "middling" American at 6·57*d.* and "fine" Bengals at $5\frac{1}{2}d.$ per lb. A sample of Pernambuco ("Kidney") seed-cotton from Burma was also examined. The lint was of good length and would be readily saleable in the United Kingdom; it was valued at 9*d.* to $9\frac{1}{4}d.$ per lb., with "good" rough Peruvian at $9\frac{1}{4}d.$ and "middling" American at 6·57*d.* per lb.

Commonwealth of Australia.—A sample of seed-cotton from Queensland resembling Sea Island cotton in character was examined. The lint was of fairly good strength, but of irregular length, and was valued at 12·50*d.* per lb., with "choice" Georgia Sea Island at 13*d.* and "fancy" Florida Sea Island at 14*d.* per lb. A sample of Nubari seed-cotton from the same State contained a good deal of short, weak fibre, and the lint was valued at 9·25*d.* per lb., with "good fair" brown Egyptian at 9·80*d.* and "good fair" Nubari at 10·20*d.* per lb. A memorandum on the prospects of cotton growing in Queensland was supplied to the Dominions Royal Commission.

Solomon Islands.—A sample of Caravonica cotton was valued at 9·00*d.* per lb. with "good" moderately rough Peruvian at 8·85*d.*, and one of Mamara cotton, which somewhat resembled Sea Island cotton but was of darker colour and rather coarser, was valued nominally at 12*d.* per lb. with "choice" Sea Island cotton at 13*d.* per lb.

West Indies.—Seven samples of Sea Island cottons from Montserrat were reported on. They were of excellent quality, except in the case of two samples which represented the second picking, and were valued at prices ranging from 16*d.* per lb. in the case of the latter up to 19*d.* per lb., with "extra fine" Sea Island at 19*d.* and "fine" Sea Island at 16*d.* per lb. A sample of Sakellaridis cotton from Montserrat was of good quality and was valued at 11*d.* per lb. with "fine" Sakellaridis at the same price.

Foreign Countries.—A sample of ginned Fathi cotton from Egypt was of excellent quality and was valued at 12*d.* per lb. with "good" Yannovitch at 11·5*d.* and "fine" Yannovitch at 11·85*d.* per lb. A sample of seed-cotton of this variety was also examined.

A sample of Egyptian seed-cotton from the United States was examined. The lint was less soft, paler in colour and more irregular in length than standard Mitafifi cotton and its value would probably be slightly lower than "fully good fair" brown Egyptian, which at the date of the report was quoted at 9·80*d.* per lb. Seven samples of cotton from the United States were under examination at the close of the year.

Jute and Similar Fibres.

Nyasaland.—A specimen of a fibre-producing plant was reported on. It was identified at the Royal Botanic Gardens, Kew, as *Hibiscus asper*, Hook. f., and a sample of the fibre, which might be suitable for use as a jute substitute, was requested for examination.

Rhodesia.—A sample of jute from Southern Rhodesia had been badly cleaned and prepared, and was only suitable for paper-making, for which purpose it would be worth about £6 per ton.

A sample of Deccan hemp (*Hibiscus cannabinus*) from Northern Rhodesia was of good strength and varied in length from 3 feet to 6 feet. It was valued at £24 per ton in London, with "first marks" Calcutta Jute at £29 per ton.

India.—Samples of *Malachra capitata* and *Urena lobata* fibres from Bengal proved to be of excellent quality and were valued at £30 and £35 per ton respectively with "first marks" Calcutta jute at £26 5*s.* to £26 10*s.* per ton. A small consignment of *Urena lobata* fibre was subsequently received for sale in London, together with one of Sida fibre. The two consignments were sold as one lot at the rate of £36 per ton with "first native marks" Calcutta jute at £35 10*s.* to £36 per ton. The fibres were regarded by merchants as the nearest substitutes for Bengal jute that has ever come into the market, and it was stated that spinners are most anxious to obtain supplies of them. For an account of these Indian fibres see "Bulletin of the Imperial Institute," Vol. XII (1914) p. 33.

Information as to a special process for retting and preparing jute was supplied to the India Office.

Fiji Islands.—A memorandum relating to jute cultivation in Fiji was supplied to the Colonial Office.

Fibres suitable for Cordage Manufactures.

Sudan.—Specimens of Dracaena leaves yielded a strong fibre, but they were too short to furnish a product sufficiently long to be of much value for rope-making. Such fibre (about 19 inches long) would be classed with long tow and consequently would only fetch a low price.

Zanzibar.—Samples of coir ropes and matting as made in Zanzibar prisons were examined. The former was very well made and there would be a good market for such rope in the United Kingdom.

Rhodesia.—Three samples of "Lukushi" fibre (*Sansevieria* sp.), prepared in different ways, from Barotseland, were of good strength, but their length did not exceed 21 inches. Fibre such as this would be worth about £20 per ton in the United Kingdom, but if obtainable 3 to 4 feet long it would be equal in value to Mexican Sisal, which at the date of the report was valued at £35 per ton.

Union of South Africa.—Specimens of Sansevieria leaves and aloe fibre from Bechuanaland were examined. The former were identified at the Royal Botanic Gardens, Kew, as *Sansevieria rhodesiana*, N.E. Br., and on extraction by hand at the Imperial Institute yielded a fibre of good strength from 3 to 4 feet long, and similar in character on the whole to a good grade of Sisal hemp. If obtainable in commercial quantity and from 3 feet 6 inches to 4 feet in length the fibre would be readily saleable in the London market as a substitute for Sisal, which at the date of the report was quoted at about £26 to £27 per ton.

The aloe fibre, which was thought to be derived possibly from *Aloe Lugardiana*, was of very good appearance and mostly about 2 feet 6 inches long. It would probably be saleable in the United Kingdom as a cordage material, although the sample examined was rather short for this purpose; it was valued at £27 to £28 per ton in London (December 1913).

Nigeria.—A sample of Musa fibre from the Northern Provinces was well cleaned and prepared, of fairly good strength, with an average length of 2 feet. Such fibre would be readily saleable in the United Kingdom, if not less than 3 feet long, at about £25 to £30 per ton, but fibre of the length of the sample would be worth only £12 to £15 per ton.

Fibre of good quality obtained from the pendulous shoots of a species of Pandanus, possibly *P. Heudelotianus*, Balf. f., from the Northern Provinces was also examined.

St. Helena.—A sample of New Zealand hemp (*Phormium tenax*) prepared by a chemical process, was of good appearance and length, but of uneven strength, in the latter respect being inferior to a standard sample of this fibre from New Zealand.

India.—A sample of fibre extracted from the fresh leaf-stalks of wild plaintain from Burma proved to be of good quality and was valued at £35 per ton in London, with "fair current" Manila hemp at £33 per ton. This fibre would be suitable for fine spinning and would be readily saleable in this country. A sample of the same fibre prepared by retting was very similar to the preceding sample in most respects, but was of darker colour and consequently less valuable.

Three samples of supposed Musa fibres from India were also examined.

Federated Malay States.—A sample of Sisal hemp proved to be less strong than standard East African Sisal and was valued at £25 per ton in London with Mexican Sisal at £26 per ton. Such fibre would be saleable in large quantities for cordage manufacture.

New Zealand.—A sample of *Phormium tenax* fibre prepared by a special process was examined and reported on.

Solomon Islands.—A sample of Musa fibre was under examination at the close of the year.

Foreign Countries.—Two samples of Zapupe fibre from Mexico were of excellent quality and were valued at £32 and £30 per ton respectively in London, with Mexican Sisal at £34 and best quality Mauritius hemp at £28 to £30 per ton.

Paper-making Materials.

Sudan.—Dom palm leaves were under examination at the close of the year.

India.—Information was supplied to the Government of Rewah State on the manufacture of paper pulp on a small scale from grasses and bamboos.

Ceylon.—Small cards made from the leaves of the palmyra palm (*Borassus flabelliformis*) were examined.

Federated Malay States.—Information was supplied to the Government relating to the utilisation of Hedychium sp. for paper making.

Sarawak.—Specimens of nipa palm leaves and petioles were reported on. A fairly good paper could be prepared from the pulp, but owing to the bulky nature of the material it would not pay to export it in a crude state; it could either be shipped in the form of "half-stuff" or be used locally for paper manufacture.

Commonwealth of Australia.—A memorandum dealing with the utilisation of prickly pear was supplied to the Prickly Pear Commission,

Queensland, and samples of the dried plant and of gum obtained from it were reported on, the former being dealt with specially from the point of view of its possible use as a paper-making material.

Foreign Countries.—A specimen of baobab fibre from Senegal, consisting of strips of the inner bark, was reported on. There was a demand for this material in the United Kingdom at one time for paper making, and the trade could no doubt be revived if a regular supply could be guaranteed. The sample examined was of rather rough appearance and was valued at £8 to £9 per ton in Liverpool (January 1913).

Miscellaneous.

A number of fibres which do not come into any of the foregoing classes were also examined.

A specimen of wild silk from Mexico, consisting of a portion of a flat, loosely spun web-like nest, was reported on. The silk could not be reeled, and it is doubtful whether it could be cleaned sufficiently to enable it to be satisfactorily carded and spun. It is improbable that nests of the kind represented by this sample would find a market among silk spinners.

Two samples of silk from Transvaal were under examination at the close of the year.

A sample of floss from Cyprus, resembling that of *Asclepias* spp., could be used as a stuffing material for upholstery, and similar material and would probably realise about 6*d*. to 7*d*. per lb. in the United Kingdom, with Java kapok at 8*d*. to 9*d*. per lb.

A specimen of flax from Nyasaland had been imperfectly retted and scutched and was only suitable for use as tow, for which purpose it was valued at £20 per ton in London (November 1913). A specimen of badly prepared tow from Nyasaland was also reported on. Flax from the East Africa Protectorate was under examination at the close of the year.

Two samples of ramie from Cyprus consisted of narrow strips of strong fibrous bark about 4 to 5 feet long. Such material would be difficult to dispose of except at a very low price, as spinners prefer the fibre prepared in the form of commercial China grass. Three samples of similar material from India were also reported on, but in one case the brown outer layer had been removed, and this sample was regarded as worth £25 per ton, with hand-cleaned China grass at £42 to £50 per ton.

A sample of so-called "nettle fibre" from India also consisted of unprepared fibrous bark. This product was quite different in character from ramie, and although similar material has been sold in London at £12 per ton, it is not advisable to place it on the market in such a condition; it might, however, be worth while preparing the fibre by a retting process.

Other fibres dealt with during the year included the stem fibre of *Vellozia* sp. from Rhodesia, and marine, eel or goose grass from Newfoundland. Two samples of broom corn brush from Nyasaland were received for examination towards the close of the year.

A large number of enquiries from merchants and others in the United

Kingdom, as well as from Colonial Governments and planters, were dealt with, relating to the cultivation, preparation and utilisation of various fibres, whilst a number of fibres were received for identification.

Rubber and Gutta Percha.

Countries of Origin :—East Africa Protectorate, Uganda, Rhodesia, Union of South Africa, Sierra Leone, Gold Coast, Nigeria, Mauritius, India, Ceylon, Federated Malay States, Papua, West Indies, British Guiana, United Kingdom, Foreign Countries.

East Africa Protectorate.—A sample of the coagulated latex of a species of Euphorbia consisted of a soft, sticky mass, exhibiting very slight elasticity and practically no tenacity. The dry material contained 87·1 per cent. of resin and only 1·7 per cent. of caoutchouc. This product would be of no value for technical use in rubber manufacture.

Uganda.—A sample of the latex of *Mimusops cuneifolia* yielded about 25 per cent. of a hard, friable, whitish coagulum, which contained 83·4 per cent. of resin and 9·4 per cent. of rubber-like material. The product could not be used as a "gutta," and the resin was unsuitable for varnish-making.

Rhodesia.—The "rubber" of an indigenous species of fig (*Ficus*) was found to contain 28·0 per cent. of caoutchouc and 68·2 per cent. of resin. A large sample of this material was asked for in order that technical trials might be carried out.

A sample of Ceara rubber from Northern Rhodesia was also submitted. The rubber had not been well prepared; it contained a good deal of impurity, and suggestions were made for its improvement.

Union of South Africa.—A sample of *Euphorbia Tirucalli* latex from Natal was under examination at the close of the year.

Sierra Leone.—A sample of Para rubber prepared from trees six years old, by coagulating the latex with lime juice, was of very satisfactory composition, but rather deficient in elasticity and tenacity. The rubber was valued at possibly 1*s.* 9*d.* per lb. in London, with fine plantation Para biscuits at 2*s* 2*d.* to 2*s.* 3½*d.* per lb. and fine hard Para rubber at 3*s.* 1*d.* per lb. A second sample obtained from 4 to 5 year old trees, the latex being coagulated by evaporation, was not quite so satisfactory in composition as the first sample, but was much superior to it in appearance and physical properties and was valued at probably 2*s.* per lb. in London. It was suggested in the report that acetic acid should be employed as a coagulant for the latex in further experiments.

Gold Coast.—A specimen of the plant known in the Gold Coast as "Kplen," the roots of which contain a gutta-like product (see Report for 1911, p. 29), was identified at the Royal Botanic Gardens, Kew, as probably *Salacia Baumannii*, Loes.

Nigeria.—Samples of Ceara rubber from the Northern Provinces, prepared by the Lewa process in strips and balls, were found to be of very fair quality, comparing favourably in composition with specimens prepared by the same process in East Africa. Ceara rubber similar to the samples would always be readily saleable in London. The strips were valued at probably about 3*s.* 6*d.* per lb., with fine hard Para at 3*s.* 11*d.* per lb., and the balls at about 3*s.* 3*d.* to 3*s.* 4*d.* per lb. It was suggested that a small trial consignment of this rubber should be prepared in strips and forwarded to the Imperial Institute for sale in London.

A thin biscuit of Para rubber prepared from 6 to 7 year old trees in the Southern Provinces exhibited excellent physical properties and was of satisfactory composition, containing 93·8 per cent. of caoutchouc in the dry material. Consignments of similar character would realise prices equal to those of plantation Para biscuits from Ceylon.

Mauritius.—A sample of the latex of *Euphorbia Tirucalli*, accompanied by herbarium specimens of the plant, was examined. The coagulum obtained from the latex was similar in composition to the material obtained in Natal, which is being utilised for certain technical purposes in Europe.

India.—Six samples of Para crêpe rubber from Burma were well prepared on the whole and satisfactory in physical properties. The amount of caoutchouc in the dry washed rubbers varied from 90·0 to 94·3 per cent. The samples were valued at from 3*s.* 2*d.* to 3*s.* 4*d.* per lb. in London, with fine hard Para at 3*s.* 4*d.* per lb.

Two samples of Castilloa rubber from Bombay were reported on. One was of good quality, and although too small for accurate valuation, it would probably have been worth from 2*s.* to 2*s.* 3*d.* per lb. in London, with fine hard Para at 3*s.* 10*d.* per lb. The other sample was soft and deficient in strength, and would probably not have realised more than 1*s.* 6*d.* to 1*s.* 9*d.* per lb.

The bark from an old vine of *Cryptostegia grandiflora*, 2 to 3 inches in diameter, yielded 2·07 per cent. of crude rubber, on extraction with hot toluene. The crude rubber, however, contained 33·8 per cent. of resin, colouring matter, etc., and would need purification before it would be saleable. It seems unlikely that the extraction of rubber from such bark as this would be profitable. Specimens of thin Cryptostegia stems $\frac{1}{8}$ to $\frac{3}{4}$ inch thick were also examined. They yielded 2·03 per cent. of crude rubber, containing 78·8 per cent. of resin, colouring matter, etc., and it is highly improbable that such stems will prove of value as a commercial source of rubber.

Ceylon.—A sample of ball Para rubber prepared by the Brazilian method of smoking the latex was examined in comparison with crêpe rubber prepared on the same estate. The smoked ball rubber lost 18·3 per cent. on washing, and the dry washed rubber contained caoutchouc 92·9 per cent., resin 4·0 per cent., protein 2·8 per cent. and ash 0·3 per cent. Technical trials conducted by manufacturers showed that the smoked rubber had a breaking strain of 2,900 lb. after vulcanisation, as compared with 2,400 lb. in the case of the crêpe rubber. The smoked rubber was therefore superior in tensile

strength to the ordinary crêpe. A sample of the smoked ball rubber was retained for further examination after an interval of six months.

A specimen of smoked block Para rubber prepared by Wickham's process was also reported on. The rubber lost 12·8 per cent. on washing and drying, and the dry washed rubber contained caoutchouc 92·1 per cent., resin 4·2 per cent., protein 3·2 per cent., and ash 0·5 per cent. Technical trials by manufacturers showed that the rubber after vulcanisation was of good quality, but slightly below the average of smoked plantation Para rubber in tensile strength and durability. It was considerably below the standard of the best Para, but higher than the lower qualities.

The first consignment of a series of rubbers specially prepared under the direction of the Rubber Research Committee of Ceylon for vulcanising and mechanical tests at the Imperial Institute was under examination at the close of the year.

Federated Malay States.—A sample of gutta percha obtained by tapping standing trees proved to be of very good quality, although the tensile strength and elongation were not quite so good as those of the best gutta percha obtained in the ordinary way. It was valued by one firm of manufacturers at 6*s.* per lb. in London (February 1913), whilst another firm stated that if it gave satisfactory results on being tested for durability it would be worth 7*s.* 6*d.* per lb.

Papua.—A sample of Para sheet rubber was of excellent quality and quite equal in every respect to the best plantation rubber produced in the East. It was valued at 4*s.* per lb., with fine hard Para at 3*s.* 11*d.* and fair average quality plantation sheets and biscuits at 3*s.* 10¾*d.* to 3*s.* 11½*d.* per lb.

British Guiana.—A sample of Para biscuit rubber obtained from 4½ to 5 year old trees proved to be slightly weak, but considering the age of the trees the physical properties of the rubber were quite satisfactory. It was valued at 3*s.* per lb. in London, with fine hard Para at 3*s.* 6½*d.*, and fair average quality plantation sheets and biscuits at 3*s.* 1½*d.* to 3*s.* 2½*d.* per lb. Scrap rubber from the same trees was of good quality and was valued at 2*s.* 6*d.* per lb. on the same date.

A sample of bastard balata was also reported on.

Foreign Countries.—Four samples of Landolphia rubber from Mozambique, prepared from the bark of the vines by mechanical treatment, were reported on, as well as a sample of the bark, while 10 samples of bark were under examination at the close of the year.

Other products from foreign countries which were reported on during the year included crêpe Landolphia rubber and *Euphorbia Tirucalli* rubber from Mozambique, the coagulated latex of *Euphorbia canariensis* from the Canary Islands, Castilloa rubber from Mexico and an artificial "rubber" from Norway.

Waxes, Oils and Oil Seeds.

Countries of Origin:—Cyprus, Sudan, East Africa Protectorate, Uganda, Zanzibar, Nyasaland, Rhodesia, Union of South Africa,

Sierra Leone, Gold Coast, Nigeria, Seychelles, Mauritius, India, Ceylon, Federated Malay States, Brunei, Fiji Islands, Canada, West Indies, British Honduras, United Kingdom, Foreign Countries.

Sudan.—A small consignment of shea kernels was received for sale in London. They contained 4·3 per cent. of moisture and 52·7 per cent. of fat, and were sold through brokers in London at the rate of £12 per ton (January 1913).

A sample of *Lophira alata* nuts was examined. They contained 56 per cent. by weight of kernels, and the latter when air-dried yielded 39·2 per cent. of a solid yellowish fat. Properly dried kernels would be worth about £10 per ton c.i.f. Liverpool (May 1913).

A small consignment of white sesamum seed was sold through brokers in London at the rate of £12 per ton (March 1913).

Information was supplied to the Sudan Government as to the generally accepted percentage of free allowance for dirt and foreign matter in consignments of sesamum seed shipped to the United Kingdom and also as to the average annual price of Indian sesamum for the last 10 years. Similar information respecting West African ground nuts and Egyptian cotton seed was also supplied.

A sample of ground nuts was of inferior quality and worth only £12 to £12 10*s.* per ton in the United Kingdom (February 1913).

East Africa Protectorate.—Two samples of linseed contained 8·1 and 7·6 per cent. of moisture and 34·8 and 36·9 per cent. of oil respectively. If exported in good clean condition such seed would realise the ordinary price of linseed, which at the date of the report was 44*s.* to 46*s.* per quarter (May 1913).

Uganda.—Seeds of *Telfairia pedata* contained 54·7 per cent. of kernels, which yielded 62·9 per cent. of a viscous, non-drying oil, suitable for soap-making and possibly for edible purposes. Up to the present it has been found impossible to utilise these seeds owing to the difficulty of shelling them. Apart from the heavy cost of freight involved in shipping the whole seeds, containing about 46 per cent. of useless husk, oil expressed from the whole seeds would not be suitable for edible purposes, as the husk contains a very bitter substance which finds its way into the oil. The residual cake made from whole seeds would also be unsuitable for use as a feeding stuff for the same reason.

Zanzibar.—The following oil seeds from Zanzibar were reported on :—Castor seed, which was about equal in value to Bombay castor seed if exported in good condition. Two samples of sesamum seed, yielding respectively 53·8 and 49·1 per cent. of oil. Ground nuts. Palm nuts, the kernels of which yielded 52·7 per cent. of oil. Kapok seed, which was saleable in Europe at the current price of such seed if marketed in commercial quantities. Para rubber seed, the kernels of which furnished 45 per cent. of oil. *Telfairia pedata* seed (see under Uganda) ; *Jatropha Curcas* seed and *Moringa pterygosperma* seed.

Nyasaland.—A sample of safflower seed yielded 29·6 per cent. of clear yellow oil. The seed was in good condition and equal to average quality Indian safflower seed, except that the percentage of moisture

was somewhat higher, and it would probably be worth about £7 10*s.* per ton in London (February 1913).

Rhodesia.—A sample of ground-nut kernels was under examination at the close of the year.

Sierra Leone.—Two samples of castor seed yielded 41·8 and 46·1 per cent. of oil respectively. The latter was much darker in colour than ordinary commercial Indian castor seed, but should realise about the same price as Bombay castor seed, which at the date of the report was quoted at £11 12*s.* 6*d.* per ton. The other sample consisted of smaller seeds, and on account of the lower yield of oil they would be slightly less valuable.

A small consignment of Carapa seeds was reported on. The kernels contained 7·5 per cent. of moisture and yielded 60 per cent. of semi-liquid oil. Previous samples of these kernels from Sierra Leone were valued at £11 5*s.* and £11 10*s.* per ton respectively (see Report for 1909, p. 30), and kernels similar to those in the present sample of seeds should realise slightly higher prices under present conditions.

A sample of palm fruits of the ordinary thick-shelled type, and inferior to those obtained in the Gold Coast and Southern Provinces, Nigeria, was examined and reported on.

The detailed examination of "gorli" seeds (*Oncoba echinata*) (see Report for 1909, p. 30) was completed and the results published in a paper by Dr. E. Goulding and Mr. N. C. Akers contributed to the Chemical Society of London ("Proceedings of the Chemical Society," Vol. XXIX, 1913, p. 197, and "Bulletin of the Imperial Institute," Vol. XI, 1913, p. 440). The fat is of special interest in containing a large proportion of chaulmoogric acid, one of the characteristic constituents of the chaulmoogra oil used as a remedy for leprosy.

Gold Coast.—A series of samples of fruits and kernels of *Pentadesma butyracea* was examined and reported on. The highest proportion of fat in the air-dried kernels was only 12·6 per cent., and such kernels would be suitable for export to Europe. A further sample of kernels examined subsequently contained 37·7 per cent. of moisture and 22·6 per cent. of fat. If thoroughly dried in the sun they would contain about 10 per cent. of moisture and 31 per cent. of fat. It is clear that the kernels of this species as collected are liable to show great variation in the amount of fat they contain, and further investigation is needed to determine the stage at which they are richest in fat and suitable for collection for export.

A sample of "owere" seeds (*Monodora Myristica*) was under examination at the close of the year.

Nigeria.—A sample of ground nuts from the Northern Provinces was of excellent quality, the nuts being larger and better than those from Nigeria usually marketed in Liverpool. They were valued at about £19 per ton (March 1913).

Beeswax prepared by Hausas in the Northern Provinces was of mixed quality, and was valued at from £6 10*s.* to £6 17*s.* 6*d.* per cwt. (April 1913). If remelted, wax of excellent appearance could be prepared from such material, which should realise £7 to £7 2*s.* 6*d.*

per cwt. Specimens of native bees forwarded with the wax were identified at the British Museum (Natural History) as *Apis mellifica*, Linn, sub. sp. *unicolor*, Latr., var. *adansoni*, Latr.

Seychelles.—A small sample of oil palm fruits of the thick-shelled type was reported on. The fruits were very large, averaging 25 grams in weight, as compared with a maximum of about 13 grams in the case of a series of samples from British West Africa previously examined at the Imperial Institute. A larger sample was asked for in order that the average quality of the fruits might be determined.

Mauritius.—A sample of "illipe" oil obtained from the seed of *Bassia latifolia* was rather softer than samples from India and Ceylon previously examined at the Imperial Institute, but it yielded a good hard yellow soap, and was valued at about the same price as good palm oil, viz., £27 to £30 per ton in Liverpool (May 1913).

India.—A sample of "raina" seeds (*Amoora Rohituka*) contained 7·5 per cent. of moisture and 43·5 per cent. of viscous oil, possessing an unpleasant smell and bitter taste. Technical trials with the oil showed that it was of fair quality for soap-making, and it should find a ready sale at a moderate price for this purpose. The residual cake could not be used for feeding cattle owing to its bitter taste, and it would be of very little value as manure. The seeds were valued nominally at £9 per ton in the United Kingdom (April 1913).

A sample of "panang" kernels (*Calophyllum Inophyllum*) contained 3·3 per cent. of moisture and 71·4 per cent. of oil, which was semi-solid at the ordinary temperature. Technical trials carried out with the oil showed that it was an excellent soap-making material, but of no value for edible purposes, while the residual cake could only be used as a manure. Kernels containing as much oil as the present sample would be worth £16 per ton in the United Kingdom (April 1913).

"Nahar" seeds (*Mesua ferrea*) were found to consist of 61 per cent. kernel and 39 per cent. shell. The sound kernels contained 3 per cent. of moisture and 75·6 per cent. of dark viscous oil, possessing a bitter taste, equivalent to a yield of 46 per cent. from the whole seed. Technical trials showed that the oil was only suitable for soap-making, for which purpose it might realise £25 to £27 per ton. The whole seeds were valued at £10 to £11 per ton in the United Kingdom (August 1913). The residual cake was bitter and could not be used as a feeding stuff.

Attempts to find an industrial process for deodorising margosa fat were unsuccessful (see Report for 1912, p. 32). It was found that the odour of the fat is due to the presence of a sulphur compound, which cannot be removed by means of solvents or by any simple and inexpensive process, and consequently there is at present no prospect of creating an export trade in margosa seeds and fat.

Specimens of the fruits of *Calophyllum tomentosum* and two samples of sardine oil were also reported on, and samples of *Schleichera trijuga* oil and cake were under examination at the close of the year.

Fiji Islands.—A sample of ground-nut oil was of good quality and

probably worth about £30 per ton in the United Kingdom for industrial purposes (September 1913), but if of better colour and appearance it would have been worth £37 or more as an edible oil. A sample of *Calophyllum Mophyllum* oil was also examined (cf. under *India*).

West Indies.—A sample of the nuts of the "gru-gru" palm (*Acrocomia sclerocarpa*) from Grenada and one of kernels from Trinidad were reported on. The kernels of the former yielded 56·2 per cent. of fat similar in type to coconut and palm kernel oils. The kernels should fetch about the same price as oil palm kernels, viz., £23 5*s*. to £24 per ton ex quay Liverpool (September 1913), but their exact value could only be determined after the fat had been tested by manufacturers on a commercial scale.

Three consignments of sugar-cane press cake from Barbados were examined and reported on. On extraction with hot alcohol they yielded respectively 9·0, 8·8 to 9·3 and 11·9 per cent. of wax. The wax extracted from the first two specimens was fairly hard and capable of taking a dull polish, while that from the third lot of press cake was softer and more greasy. Trials of the press cake on a commercial scale by firms of manufacturers indicated that it would be difficult to prepare the wax on a large scale by the processes in common use for the extraction of oils and fats by means of solvents. A sample of the wax extracted by hot light petroleum in Barbados was examined. After bleaching it was hard, opaque and free from greasiness. It produced a good polish on leather when made into a paste with turpentine oil. Further consignments of the cake were received towards the close of the year, and a supply of the wax for trial by manufacturers is now being prepared.

British Honduras.—Samples of the fruits and kernels of the cohune palm (*Attalea Cohune*) were reported on. The outer fibrous layer of the fruit contained up to 20·6 per cent. of fat similar to palm oil, but this would have to be extracted by solvent, and owing to the bulky nature of the material, its extraction in Europe on a commercial scale would probably not be remunerative. The amount of fat present in the kernels ranged from 65·4 to 71·6 per cent.; the fat was of the same type as coconut and palm kernel oils, but of somewhat softer consistency. If shipped in commercial quantities and in good condition the kernels should realise prices approximating to those of copra, viz. £29 2*s*. 6*d*. to £30 15*s*. per ton (April 1913). The fat from the kernels should be worth about the same price as coconut oil or palm kernel oil, but its exact commercial value can only be determined after it has been submitted to technical trial on a large scale.

Miscellaneous.—As in previous years a large number of enquiries from merchants, planters and others were dealt with relating to the cultivation and utilisation of various oil seeds, the machinery employed in preparing them for the market, etc., while a considerable number of oil seeds were received for identification. Among the latter may be mentioned several specimens of *Telfairia pedata*, "haibai" seeds (*Litsea sebifera*), *Hydnocarpus venenata*, "mulgees" kernels (*Buchanania latifolia*), *Dumoria Heckeli*, and "mafoureira" seeds (*Trichilia emetica*).

Volatile Oils.

Countries of Origin:—Cyprus, Sudan, East Africa Protectorate, Uganda, Zanzibar, Rhodesia, Union of South Africa, Seychelles, Mauritius, India, Federated Malay States, Hong Kong, Fiji Islands, West Indies, United Kingdom, Foreign Countries.

Cyprus.—A sample of oil, distilled from a species of sage known as "Sfatsa," differed markedly from commercial sage oil in character, and there would be no market for such oil in London. It closely resembled a sample derived from *Salvia cypria* previously examined at the Imperial Institute.

Harbarium specimens of several species of Origanum were received. They were identified at the Royal Botanic Gardens, Kew, as follows: the plant from which Cyprus origanum oil is distilled, *O. dubium*, Boiss.; wild marjoram ("Sampsisha"), *O. majoranoides*, Willd.; plant found near Lapithos ("Rikhanon"), *O. Onites*, L.

Sudan.—The oil from *Cymbopogon senaarensis*, Chiov. grass was under examination at the close of the year.

Uganda.—A sample of "tete" grass oil was found to belong to the lemon grass type, but was of poor quality, containing less than half the quantity of aldehydes usually present in good lemon grass oil. The botanical origin of this oil is doubtful, and herbarium specimens have been requested for identification, as well as a quantity of the grass for distillation at the Imperial Institute.

Rhodesia.—Information was supplied to the Government of Rhodesia on machinery for the extraction of citrus oils.

Union of South Africa.—A sample of "sherungulu" tubers was under examination at the close of the year.

Seychelles.—A portion of a sample of ylang ylang oil, originally examined in 1910, was re-examined, in order to ascertain whether any change had taken place after 3 years' storage. The only noteworthy feature was that the ester value showed a slight increase, equivalent to an additional 4 per cent. of esters. A new sample of ylang ylang oil was received for examination and commercial valuation at the close of the year.

Mauritius.—Two samples of *Eucalyptus citriodora* oil proved to be of excellent quality and similar oil would be readily saleable in the United Kingdom. There would be a limited use for it for certain special purposes at prices varying from 4*s*. to 5*s*. per lb., but if shipped in large quantities it would realise about 2*s*. to 2*s*. 6*d*. per lb. as a soap perfume.

A sample of *Eucalyptus tereticornis* oil possessed physical and chemical properties which differed considerably from those recorded previously for oil of this species. The oil was regarded by experts as of no commercial interest.

Three samples of camphor oils differed greatly from commercial camphor oils and information as to their origin was asked for.

At the end of the year the following essential oils from Mauritius were under examination: camphor leaf oil, camphor root oil, camphor twig oil (2 samples), camphor wood oil, clove oil (2 samples), clove leaf oil (3 samples), and ylang ylang oil.

India.—Five samples of Cochin lemon grass oil were examined, with a view to determining the cause of the change in solubility which has recently occurred in the lemon grass oil shipped from Cochin. The results of the experiments indicated that the "insolubility" was due to the distillation having been carried too far. In continuation of this investigation two oils described as having been obtained from "white-stemmed" and "red-stemmed" lemon grass respectively, were examined. The former belonged to the citronella type, while the latter was a true lemon grass oil.

Federated Malay States.—Two samples of camphor oil were reported on. The first yielded 19·3 per cent. of camphor on cooling to –10° C., and the second 12·8 per cent. on cooling to –12° C. In each case the residual oil contained no safrole, and thus could not compete with Japanese camphor oil, the value of which depends chiefly on the safrole present. The exact commercial value of such oil is at present doubtful, but an English expert stated that the first sample, after the removal of the camphor by freezing, should be worth 7½*d.* or 8*d.* per lb. in London, whilst a German firm considered that it might possibly be worth about 30*s.* per cwt. delivered in Europe. The second sample was being submitted to more detailed investigation at the close of the year.

A sample of crude camphor was found to contain 88 to 89 per cent. of camphor and 11 to 12 per cent. of oil. It was similar to Chinese "leaf" camphor and was valued at £6 to £6 5*s.* per cwt. in London, with Japanese monopoly B. camphor at £7 2*s.* 6*d.* per cwt.

Hong Kong.—The volatile oil obtained by distillation from a sample of *Alpinia alba* (*Amomum medium*) fruits was submitted to detailed examination and the results published in a paper by Dr. S. S. Pickles and Mr. J. C. Earl, of the Scientific and Technical Department staff, in the "Proceedings of the Chemical Society," Vol. XXXIX (1913), p. 164. The chief constituents of the oil were found to be cineole (eucalyptol) and citral. The yield of oil from the fruits is only 1·16 per cent., and it seems unlikely that it would pay to collect and distil them, especially as cineole and citral are obtainable cheaply in large quantities from other sources.

A sample of camphor oil was under examination at the close of the year.

Fiji Islands.—A sample of distilled oil of limes closely resembled the ordinary distilled oil of limes imported from the West Indies, the current value of which was 2*s.* 6*d.* to 2*s.* 9*d.* per lb. in London (December 1913).

A small consignment of *Cymbopogon coloratus* oil was received for

sale in London. It consisted of a deep yellow, fairly mobile oil with a strong lemon-like odour. It was sold in London at 2*d*. per oz. (January 1913), i.e. above the current value of citronella oil, but below that of lemon grass oil. A portion of this consignment was reserved for detailed chemical examination and this work was in progress at the close of the year. A sample of vetiver oil was also under examination.

Foodstuffs and Fodders.

Countries of Origin:—Sudan, East Africa Protectorate, Uganda, Zanzibar and Pemba, Nyasaland, Sierra Leone, Gold Coast, Nigeria, Seychelles, India, Ceylon, Federated Malay States, Papua, West Indies, British Guiana, United Kingdom, Foreign Countries.

Cereals.

Sudan.—Three varieties of wheat—"Egyptian," "Dongola" and "Indian"—grown under irrigation at the Gezira Experimental Station, Tayiba, were chemically examined and then submitted to a technical expert for milling and baking tests. It was found that all three wheats behaved on the whole like average Indian wheats as met with in commerce. The "Dongola" wheat yielded the best flour of the three.

Samples of rice grown in the Bahr-el-Ghazal Province and in the Nuba Mountains Province were considered by merchants to be too soft to compete with the hard rices generally milled in Europe, and were valued at from 7*s*. 6*d*. to 9*s*. per cwt. in London, or possibly more if well cleaned and sifted.

Information was supplied to the Government on the following subjects:—The average yearly prices of Indian wheat, South American maize, and Russian barley during the years 1903 to 1912 inclusive; the generally accepted percentage of free allowance for dirt and foreign matter in consignments of dura shipped to the United Kingdom; and the cultivation of "dukhn" (*Pennisetum typhoideum*). In the latter case a supply of seed of a special variety was obtained from Nigeria for cultivation trials in the Sudan.

Zanzibar and Pemba.—Eight samples of unhusked rice were reported on. There is no market for unhusked rice in the United Kingdom, but one of the samples, typical of the series, was husked at the Imperial Institute, and the husked grain was valued at 10*s*. to 10*s*. 6*d*. per cwt. ex ship London (April 1913). Other cereal grains reported on included dura (*Sorghum vulgare*), *Pennisetum typhoideum*, *Setaria* sp., *Eleusine coracana* and maize. All of these would be saleable in this country if shipped in good condition.

Nigeria.—Two samples of millets from *Pennisetum typhoideum* and *Eleusine coracana* from the Northern Provinces were examined.

Information was supplied to the Government regarding the treatment of weevil-infested maize.

India.—A memorandum on the cultivation of "hill" rice was furnished to H.H. the Raj Rana of Jhalawar.

The question of the quality of the Indian barley imported to the United Kingdom for malting purposes was discussed with the Director-General of Commercial Intelligence in India, and with expert referees in the United Kingdom, who met several times at the Imperial Institute for this purpose. Fifteen samples of barley from the Punjab were chemically examined with a view to determining their suitability for malting. Sixteen further samples from the same source were under examination at the close of the year.

Leguminous Seeds.

Zanzibar.—The following seeds were examined and reported on :—"Kunde" (*Vigna Catjang*), "chooko" (*Phaseolus Mungo*), "fiwi" (*Dolichos Lablab*), "mbaazi" (*Cajanus indicus*), and "njugu mawe" (*Voandzeia subterranea*).

Nyasaland.—A sample of mixed white and brown chick peas (*Cicer arietinum*) was valued at about £6 10*s*. per ton in the United Kingdom (February 1913). If the white peas could be marketed alone their value would probably be higher.

A sample of mixed red and yellow lentils was valued at £6 to £7 per ton in the United Kingdom, and if all were of the red variety the product would be worth £8 to £9 per ton (February 1913).

Samples of black and white velvet beans (*Stizolobium aterrimum* and *S. niveum*) were each valued at £5 10*s*. to £7 per ton in the United Kingdom as feeding stuffs for animals (February 1913).

Sierra Leone.—Two samples of "towé" beans (*Phaseolus lunatus*), one of which was white with black or very dark reddish-brown markings, and the other of pinkish-brown colour with faint grey and black markings, were examined and found to yield 0·025 and 0·03 per cent. of prussic acid respectively. In view of this fact the beans could not be recommended for local consumption in Sierra Leone or for export to the United Kingdom.

A sample of "kroo" beans (*Vigna Catjang*) was valued at £5 10*s*. to £5 15*s*. per ton in the United Kingdom as a feeding stuff for cattle (July 1913).

Nigeria.—A sample of *Kerstingiella geocarpa* pods from the Northern Provinces was examined and reported on. The results of analysis of the seeds showed that they had a high nutritive value, and if the yield of seeds is satisfactory, the plant should be valuable for extended cultivation in the Northern Provinces.

A sample of white beans with yellowish-brown stains from the Northern Provinces was valued at 6*s*. per cwt. in London (August 1913), but if similar seeds free from stains could be produced they would be worth 12*s*. to 14*s*. per cwt.

India.—Samples of Madagascar beans and Victoria peas grown experimentally in Burma from seed supplied by the Imperial Institute were examined. The former were of good quality and would realise the ordinary price of Madagascar beans, the "spot" price of which in London in September 1913 was 23*s*. per cwt. They yielded on

hydrolysis 0·005 per cent. of prussic acid, as compared with 0·0025 in the case of the original seed. The Victoria peas were also of good quality, but were rather smaller than the original seed from which they were grown; they were valued on the above date at £8 to £10 per ton in London.

Eight samples of Rangoon beans from Burma were also examined, but no valuations were obtained, as they were only of interest in connection with selection experiments which are in progress in Burma. The yield of prussic acid in the case of these beans ranged from 0·01 to 0·055 per cent.

West Indies.—Bengal beans (*Stizolobium aterrimum*) from St. Vincent were in good condition, and were valued at £5 10*s*. to £7 per ton in the United Kingdom (February 1913) as a feeding stuff for cattle.

Tea, Coffee and Cocoa.

Sudan.—A small consignment of Abyssinian coffee, consisting of medium-sized to large beans, was sold through brokers in London at 64*s*. per cwt., with ordinary Abyssinian coffee at 75*s*. to 80*s*. per cwt.

Uganda.—A sample of tea was under examination at the close of the year.

Nigeria.—Five samples of cocoa produced in the course of fermentation experiments were being examined at the end of the year.

Fruits.

East Africa Protectorate.—Five samples of lemons were examined and reported on. In the best sample the fruits averaged 3½ inches in length and 2¼ inches in diameter, and were valued at 8*s*. to 9*s*. per box of 200 fruits if carefully graded for size (August 1913).

The examination of baobab fruits and seeds (*Adansonia digitata*) was concluded, and the results published by Mr. R. G. Pelly, F.I.C., of the staff of the Imperial Institute, in the "Journal of the Society of Chemical Industry," Vol. XXXII (1913), p. 778. The fruit pulp was found to contain free citric acid and possibly a small amount of malic acid, but the greater part of the acidity of the pulp is due to an acid or acids of the pectic type. It is highly improbable that the pulp would be of any commercial value, except locally in East Africa as a rubber coagulant or for the preparation of pleasantly acid drinks. The seeds contained only 11·6 per cent. of oil and would thus not be of commercial value as a source of oil.

Union of South Africa.—A memorandum on South African fruit was furnished to the Government. The subjects dealt with in the memorandum included the causes of sterility in fruit trees, the harvesting of fruit for export over long distances, packing and transport, marketing of South African fruit in England, etc., and more detailed investigations into these and allied matters were in progress at the end of the year.

Spices.

Two samples of turmeric from Sierra Leone contained 4·2 and 5·3 per cent., respectively, of volatile oil, as compared with a yield of 5 to 5·5 per cent. from commercial turmeric roots. They differed in certain respects from ordinary turmeric (*Curcuma longa*) and a definite value could not be assigned to them, and it was suggested that an experimental consignment should be sent to London for sale.

A sample of small fruits, apparently of *Capsicum minimum*, from the Sudan were of uneven colour and somewhat shrivelled, and were valued at not more than 14*s*. per cwt. in the United Kingdom (February 1913).

Two samples of chillies of poor appearance and lacking in pungency from the Virgin Islands were valued at 17*s*. 6*d*. and 27*s*. 6*d*. per cwt. respectively in the United Kingdom (November 1913). Capsicum fruits, as well as a sample of ginger, from Zanzibar, were also examined.

Miscellaneous.

Feeding trials with Para rubber seed cake were carried out for the Imperial Institute at the South-Eastern Agricultural College, Wye. A full account of these and of previous feeding trials of the cake with sheep and cattle has been published in the "Bulletin of the Imperial Institute," Vol. XI (1913), p. 533.

A sample of *Schleichera trijuga* seed cake from India was under examination at the close of the year.

Memoranda on the manufacture and use of compressed fodder in Australia, South Africa, Italy and elsewhere, were supplied to the Department of Agriculture, Bombay.

In view of the fact that millet and guinea corn (dura) plants at certain stages in their growth are poisonous to cattle and horses in Nigeria, investigations have been carried on at the Imperial Institute for some years with a view to ascertaining at what period the plants yield the largest proportion of prussic acid, the substance to which their toxicity is due. During 1913 a series of 12 samples of millet and guinea corn plants, collected at various stages of growth in the Kano Province, Nigeria, were examined, and a further set of samples of millet and guinea corn plants from Lokoja was under examination at the close of the year.

The results of examination of a new variety of "manna" found on the leaves of *Gymnosporia* sp. in Rhodesia were published by Messrs. Furlong and Campbell, of the staff of the Imperial Institute, during the year ("Proceedings of the Chemical Society," Vol. XXIX 1913, p. 128). The material was found to contain 54 per cent. by weight of dulcitol.

Considerable interest is being taken at the present time in the utilisation of waste fruits and other products containing starch or sugar as sources of alcohol. In this connection information was supplied to the Colonial Office regarding the production of industrial alcohol in the British Colonies and Protectorates, and an enquiry from the Government of the Fiji Islands as to the manufacture of alcohol from bananas was being dealt with at the close of the year.

In addition to the foregoing enquiries, most of which involved chemical work, a number of specimens of cereals, pulses, feeding

stuffs, etc. were received for identification, whilst a large number of enquiries from merchants, planters and others relating to the cultivation, marketing or utilisation of such materials were dealt with.

Tobaccos.

Countries of Origin :—East Africa Protectorate, Uganda, Nyasaland, Rhodesia, Gold Coast, India, Ceylon, Bermuda, United Kingdom, Foreign Countries.

East Africa Protectorate.—Samples of three Virginian tobaccos and four Turkish varieties grown experimentally at Kabete were examined. The tobaccos burnt fairly well, but the aroma was poor. The season in which these tobaccos were grown was not a good one for tobacco, and as the result of a first experiment the tobaccos were not altogether unsatisfactory. When a type of tobacco suitable to the soil and climate has been found, it should be possible to grow tobacco of excellent quality in East Africa in normal seasons. The Virginian tobaccos were valued at from 4*d.* to 6*d.* per lb., and the Turkish varieties at from 5*d.* to 6*d.* per lb.

Rhodesia.—Three samples of tobacco from Southern Rhodesia were under examination at the close of the year.

Gold Coast.—A sample of native grown tobacco and one grown at the Agricultural Station, Coomassie, were of poor quality, but the latter sample represented tobacco which could possibly be used as a substitute for the cheaper varieties of Kentucky leaf if it could be marketed in the United Kingdom at less than 4*d.* per lb.

India.—A sample of "White Burley" tobacco grown at Nadiad, Bombay, was under examination at the close of the year.

United Kingdom.—Two samples of cigarettes made from Turkish and Virginian tobaccos, respectively, grown in Ireland were reported on, and information was supplied regarding the cultivation of Turkish tobacco.

Foreign Countries.—Six samples of Virginian tobacco from Mozambique were rather dark in colour, but such tobacco would be readily saleable in the United Kingdom, though at rather low prices. The samples were valued at prices ranging from 5*d.* to 8*d.* per lb. (January 1913).

Gums and Resins.

Countries of Origin :—Sudan, Somaliland, Uganda, Nyasaland, Rhodesia, Union of South Africa, Gold Coast, Nigeria, Mauritius, India, Commonwealth of Australia, Solomon Islands, Foreign Countries.

Sudan.—A sample of so-called frankincense (olibanum) yielded on examination 47·4 per cent. of yellowish-brown transparent resin, 36·8 per cent. of gum, and 0·6 per cent. of volatile oil, and a sample of oleo-resin yielded 63·9 per cent. of resin, 3·9 per cent. of volatile

oil and a very little gum (0·9 per cent.). Herbarium specimens of the tree yielding the first sample were identified at the Royal Botanic Gardens, Kew, as *Commiphora pedunculata*, Engler. Both samples were forwarded as frankincense, but they differed from ordinary frankincense, and there would be difficulty in finding a market for consignments of these products in Europe.

A sample of Gafal gum-resin was found to possess very little fragrance, being greatly inferior to commercial frankincense in this respect, and the product would not be readily saleable in Europe, except perhaps at low prices. A Trieste firm thought it might be saleable at 10*s*. per cwt. delivered in Trieste.

Somaliland.—An extensive series of products, comprising 12 samples of Acacia gums, 13 samples of gum-resins, including authentic samples of myrrh, frankincense and bdellium, and 2 samples of resins, were examined and reported on. A full account of the results of their examination, together with their botanical identifications as far as these are known, has been published in the "Bulletin of the Imperial Institute," Vol. XII (1914), p. 11.

Uganda.—A resinous substance similar to lac, secreted by *Tacchardia decorella*, was under examination at the close of the year.

Rhodesia.—Samples of "mokako" and "mosheshe" gums from Barotseland were examined and reported on. The latter was similar to a gum from North West Rhodesia examined at the Imperial Institute in 1909, which was valued at 22*s*. 6*d*. to 25*s*. per cwt. The "mokako" gum would not be readily saleable in the United Kingdom so long as Sudan and West African gums of better quality are available at the present low rates.

Union of South Africa.—Pods of *Copaifera Mopane* were under examination at the close of the year.

Gold Coast.—Samples of copal were being examined at the end of the year.

Nigeria.—Several gums from the Northern Provinces were examined and reported on. Three samples of "golawai" gum (*Acacia campylacantha*) proved to be of "semi-soluble" type and worth nominally 15*s*. to 17*s*. 6*d*. per cwt.

Two samples of "katalabo" gum (*Acacia Sieberiana*) were of promising quality, being of "soluble" type. They were valued at 22*s*. 6*d*. to 24*s*. per cwt. with "glassy" Khartum gum at 31*s*. per cwt.

A sample of "kingur" gum (*Acacia* sp.) consisted of gum mixed with a resin, and would be of no commercial value in the United Kingdom. A further sample of the clean gum was requested for examination.

A small consignment of "kol kol" gum (*Acacia Senegal*) was received for examination and sale towards the end of the year. Oleoresin of *Daniella thurifera* from the Northern Provinces was also under examination at the close of the year.

Mauritius.—A sample of the oleo-resin of *Canarium Colophania* was similar to, but not identical with Manila elemi, and in view of the very small demand for products of this type it would be practically impossible to sell this oleo-resin under present conditions in the United Kingdom at a remunerative price.

India.—The results of a first series of technical trials with "thitsi" (Burmese black varnish) were reported during the year. A firm of cabinet-makers stated that this material was found to be quite as serviceable as Chinese lacquer, and they were placed in communication with producers in Burma. Further trials with "thitsi" were in progress at the end of the year.

Oleo-resin of *Pinus longifolia* was under examination and therapeutical trials with the oleo-resin of *Hardwickia pinnata* were in progress at the close of the year.

Commonwealth of Australia.—Information was supplied to the Commonwealth Government as to the uses of yellow Xanthorrhœa (grass tree) gum.

Solomon Islands.—A sample of copal resin was under examination at the close of the year.

Drugs and Poisonous Plants.

Countries of Origin:—Somaliland, East Africa Protectorate, Uganda, Zanzibar, Rhodesia, Union of South Africa, Sierra Leone, Nigeria, India, Ceylon, Commonwealth of Australia, Papua, Fiji Islands, Canada, West Indies, United Kingdom, Foreign Countries.

Somaliland.—Specimens of eleven native medicinal plants were received for identification. Six of them were indeterminable from the material supplied, and notes on the medicinal value of the remainder as far as these were known, were furnished.

Uganda.—Eighteen specimens of medicinal plants were received and information regarding their medicinal properties, so far as these have been determined, was supplied.

Zanzibar.—A sample of *Caesalpinia Bonducella* seed was received and information was supplied as to its use in medicine in Mexico.

Rhodesia.—The leaves and seeds of *Tephrosia Vogelii*, used in Rhodesia as a fish poison, were examined. The leaves were found to contain 0·15 per cent. of tephrosin, a substance already isolated by Hanriot in France from this plant and shown by him to be toxic. The examination of the seeds was in progress at the end of the year.

Union of South Africa.—An interim report was furnished on the results of examination of Cape slangkop (*Ornithoglossum glaucum*), which is poisonous to stock in South Africa. An intensely poisonous constituent, which has not yet been separated in a pure state, was shown to be present in the bulbs of the plant. Pharmacological

trials showed that preparations of this substance exerted an intensely poisonous action on frogs and small mammals, the effect produced being typical of the digitalis group of heart poisons.

Other South African poisonous plants and drugs under examination at the close of the year included *Acokanthera venenata* leaves and stems, *Dichapetalum cymosum* leaves, *Crotalaria Burkeana*, *Leonotis Leonurus*, *Homeria pallida*, *Chrysophyllum viridifolium* bark, *Urginea Burkei* bulbs, *Barosma venusta* leaves, and the barks of *Strychnos Henningsii* and *Gonioma Kamassi*.

India.—A detailed account of the results of examination of an extensive series of samples of opium from the chief opium-producing districts of India was furnished to the Government of India.

The roots of *Thalictrum foliolosum* examined for the Imperial Institute by Professor W. H. Perkin, F.R.S., were found to contain berberine, but no other important constituent.

The results of the chemical examination of the seeds of *Peganum Harmala*, which had been supplied to Professor W. H. Perkin, F.R.S., for investigation, were furnished to the Government of India, as well as the results of pharmacological trials conducted by Dr. James A. Gunn, of the Pharmacological Laboratory, University of Edinburgh, with harmaline and harmine, the two alkaloids present in the seeds.

A sample of wild *Podophyllum Emodi* rhizomes was found to contain approximately 2·5 per cent. of podophyllotoxin and 13·6 per cent. of crude resin (podophyllin).

The material from India under examination at the close of the year included samples of morphine and codeine made at the Government factory at Ghazipur, a series of *Aconitum* spp., and the flower-heads of *Artemisia maritima*, Linn.

Commonwealth of Australia.—*Zanthoxylum brachyacanthum* bark from New South Wales and Queensland was examined for the Imperial Institute by Dr. H. A. D. Jowett and Dr. F. L. Pyman, who published the results of their work during the year ("Journal of the Chemical Society," Vol. CIII (1913), p. 290).

Homeria miniata stems and leaves were under examination at the close of the year, and the examination of *Daphnandra micrantha* bark was undertaken for the Institute by Dr. H. A. D. Jowett.

Miscellaneous.—The drugs and poisonous plants under examination at the end of the year, in addition to those already mentioned, included *Croton Elliottianus* seeds from the East Africa Protectorate; roots of the "bitter-leaf tree" (*Vernonia amygdalina*) from Sierra Leone; "gigeya" plant, "agwa" leaves and pods (*Strophanthus hispidus*) from the Northern Provinces, Nigeria; coca leaves and *Adhatoda vasica* leaves from Ceylon; and *Senecio Jacobaea* from Canada.

Tanning Materials and Dyes

Countries of Origin:—Sudan, Somaliland, East Africa Protectorate Zanzibar, Rhodesia, Sierra Leone, Nigeria, India, Ceylon, Common wealth of Australia, United Kingdom.

Sudan.—"Sant" pods, the fruits of *Acacia arabica*, contained 27·2 per cent. of tannin, the yield from the pod-cases alone being 38·9 per cent. An experimental consignment of pods was received for sale towards the end of the year.

The stems of "tartous" (*Cistanche lutea*), used in the Sudan in preparing skin bottles, yielded only 13·3 per cent. of tannin, and an infusion of the stems gave a stiff reddish leather. They would not be suitable for use in tanning in Europe.

Somaliland.—The pod-cases of *Acacia arabica* yielded 23·1 per cent. of tannin, which is much below the normal (see above). A sample of "jirma" bark contained only 8·1 per cent. of tannin.

East Africa Protectorate.—Five samples of black wattle bark obtained from three year old trees contained from 35·9 to 37·2 per cent. of tannin and a sample obtained from a five year old tree contained 36·9 per cent. The latter was valued at £7 10*s.* per ton in London (May 1913), and consignments of similar bark would be readily saleable in London or Hamburg. Further samples of wattle bark were received for examination towards the end of the year.

Rhodesia.—A specimen of a so-called gum ("mutuya" gum) from Barotseland contained 70·9 per cent. of tannin, and similar material would be saleable in Europe as kino, but would only realise a low price in competition with Indian kino.

Ceylon.—A sample of *Terminalia glabra* bark contained 27·2 per cent. of tannin, but as it presented certain difficulties in use as a tanning material it is not likely that it could be profitably exported to the United Kingdom, although it could be used in Ceylon in preparing leather either for local use or export.

TIMBERS.

Countries of Origin:—Uganda, Rhodesia, Nigeria, India, British Guiana, United Kingdom, Foreign Countries.

Rhodesia.—A specimen of wood charcoal was of good quality for use as a gas-producer fuel. It had a calorific value of 7,218 small calories, and for use in a suction gas plant its value would be but little below that of anthracite.

Nigeria.—A report on the mechanical properties of teak from the Southern Provinces was furnished to the Government. The results showed that the wood was inferior to Burma teak in transverse strength, and about equal to the latter in resistance to compression, but it would be necessary to test a number of specimens before trustworthy average figures could be obtained for comparison. The working properties of the timber were excellent and the commercial experts reported that if such wood can be supplied in bulk, free from knots, it could be used for any purpose for which East Indian teak is employed.

A specimen of *Triplochiton Johnsonii* timber from the Southern Provinces somewhat resembled a light-coloured mahogany, and as

a substitute for the latter would be superior to American whitewood. It worked easily with both machine and hand tools, was light in weight, strong and fairly elastic and would be suitable for general joinery work.

A memorandum was furnished to the Director of Agriculture, Northern Provinces, suggesting species suitable for planting for fuel in the dry sandy regions north of Kano.

India.—Particulars relating to the manufacture of so-called "synthetic" timber were supplied to the Imperial Forest Economist.

Foreign Countries.—A specimen of *Khaya nyasica* timber from the Mozambique Company's Territory was classed as a good average African mahogany, and if logs of good dimensions and in sound condition could be supplied the wood should realise about 2*s.* 9*d.* to 3*s.* 3*d.* per foot cube. A small trial consignment of "M'zimbiti" wood (*Androstachys Johnsonii*) from Mozambique was sold through brokers at the rate of 2*s.* 6*d.* per foot cube.

Plant Pests and Diseases.

Countries of Origin:—East Africa Protectorate, Uganda, Nigeria, India, United Kingdom, Foreign Countries.

A number of insect pests and fungoid diseases of tropical economic plants were reported on during the year. The insect pests were identified, where possible, for the Imperial Institute by the British Museum (Natural History) or the Imperial Bureau of Entomology, whilst the fungoid diseases were identified at the Royal Botanic Gardens, Kew. The following pests and diseases, among others, were dealt with: beetles and larvae attacking Triplochiton timber; grain beetles affecting stored maize in Nigeria; the larvae of a Longicorn beetle attacking Ceara rubber trees in the East Africa Protectorate; an insect which attacks coffee and cocoa trees in Uganda; scale insects affecting orange leaves, and *Hemileia vastatrix* attacking coffee leaves in Uganda. A sample of diseased coffee beans from the East Africa Protectorate was under examination at the close of the year.

Miscellaneous Investigations.

Countries of Origin:—Sudan, Somaliland, East Africa Protectorate, Zanzibar, Nyasaland, Rhodesia, Union of South Africa, Gold Coast, Nigeria, Seychelles, India, New Zealand, Canada, West Indies, Falkland Islands, United Kingdom, Foreign Countries.

A number of vegetable and animal products which do not readily fall into any of the preceding classes were examined during the year, and the work on these may be briefly summarised as follows. A small consignment of mother-of-pearl shells from the Sudan, was sold through brokers. Most of them were disposed of at the rate of 62*s.* 6*d.* per cwt., but one case realised £8 per cwt. and two others £6 per cwt. (February 1913). A small supply of pearls from the Sudan was under examination at the close of the year. The other animal products reported on included moleskins from the East Africa Protectorate; ox hide from Rhodesia; shells from New Zealand; and diseased fish from Seychelles.

A sample of water from the Falkland Islands was reported on and 11 samples from the Bahamas were under examination at the close of the year.

Roots of *Mesembryanthemum Mahoni*, used in South Africa as a substitute for yeast, were under examination for the Imperial Institute by Prof. Adrian Brown at Birmingham University, with a view to identifying the micro-organism which sets up the fermentation.

Information was supplied to the Government of Rhodesia on the preparation of citric acid and citrate of lime.

General Enquiries.

The foregoing sections describing the work of the Scientific and Technical Department relate mainly to materials submitted for investigation through official channels, or to samples forwarded by merchants for identification. In addition to this class of work a large number of enquiries, involving scientific and technical questions, are received each year. These enquiries are chiefly of two classes: (1) requests for advice from officials of technical departments in the Colonies and India as to the cultivation of new products, the commercial value of little known materials, or methods of marketing produce, and (2) requests from merchants and manufacturers, chiefly in the United Kingdom, for information as to new sources of raw materials, advice regarding the production of raw materials in the Colonies, &c.

The number of such enquiries dealt with in 1913 was 446, exclusive of those relating to settlement, emigration and similar matters. The following statement classified into separate groups of products, will indicate the scope and variety of these enquiries.

Minerals.—Sixty-five enquiries regarding the occurrence, use, market values, etc., of various minerals were dealt with. Of these the following may be quoted:—

Request for information as to the occurrence of thoria minerals in Ceylon.
The utilisation of powdered crystalline quartz in the pottery trade.
The occurrence of mineral pitch in the East Africa Protectorate.
The occurrence and uses of uranium ore.
The comparative values of bismuth ores.
The occurrence of copper ore in Newfoundland.
Information as to coal and tungsten in India.
The occurrence and uses of titanium ores.
The utilisation, demand and market prices of infusorial earth.

Fibres.—Eighty-one enquiries relating to the sources of supply, uses, methods of preparation and marketing of various fibres, fibre machinery, etc., were dealt with. The products concerned included cotton, Sisal hemp, pineapple fibre, New Zealand hemp, *Calotropis procera* fibre, jute and jute substitutes, flax, ramie, silk, kapok, and a large number of paper-making materials, including elephant grass, papyrus, bamboos, *Hedychium coronarium* and paddy husks.

Rubber.—Twenty-one enquiries on the subject of rubber planting, methods of preparation of rubber, etc., were dealt with.

Oil Seeds and Oils.—One hundred and one enquiries regarding the sources of supply of various oil nuts and seeds, yield of oil, uses and market values were dealt with. The principal enquiries referred to the following products and the oils yielded by them: oil palm fruits, coconut, cohune nut, sesamum seed, Para rubber seed, perilla seed, castor seed, illipé seeds, *Salvadora persica* seeds, linseed, ground nuts, and soy beans.

Foodstuffs and Fodders.—Forty-eight enquiries on the subject of foodstuffs and fodders were dealt with, and information was furnished on the following subjects among others:—the extraction of sugar from the Nipa palm, cocoa, Florida beans, coffee cultivation, potatoes, *Leucaena glauca* seeds, drying of apples, preparation of apple slices and apple vinegar, rice and its cultivation, cultivation of cassava, sugar cultivation, banana flour, molasses, Madagascar beans, and Bengal beans.

Tobacco.—Nine enquiries on the subject of tobacco were dealt with and information was furnished regarding its cultivation and preparation; preventive measures against various tobacco pests were also suggested.

Gums and Resins.—Fifteen enquiries relating to gums and resins were dealt with. General information as to sources of supply, uses, etc., was furnished.

Tanning Materials and Dyes.—Eleven enquiries on the subject of tanning materials and dyes were dealt with, including the supply of information regarding the manufacture of wattle bark extract, and the comparison of natural and artificial indigos.

Medicinal and Poisonous Plants.—Ten enquiries relating to medicinal and poisonous plants were dealt with.

Timbers.—Thirteen enquiries relating to various timbers were dealt with, including the following:—"opepe," "m'Julu maza," "okoumie" (*Aucoumea Klaineana*), cedar (British Guiana), *Triplochiton Johnsonii*, Eucalyptus, etc. A memorandum was also furnished regarding the commercial demand for Andaman woods.

Miscellaneous.—Seventy-two miscellaneous and general enquiries were dealt with and some examples of these are given below:—

Dry farming.
The preparation of alcohol from sugar.
Starch yielding plants.
Destruction of insect pests.
The preservation of hides.
Ant exterminator.
Weed killers.
Cattle suitable for breeding in Nigeria.
The pearl industry in Australia and Ceylon.
Bleaching of sponges.
Manufacture of citric acid.
Manufacture of glass.
Manufacture of charcoal and wood spirit.

VIII.—SUBSIDIARY WORK.

The fifteenth, sixteenth and seventeenth sessions of the Tropical African Services Course of Instruction to candidates selected by the Colonial Office for administrative appointments in East and West Africa were held during the year.

During the year, meetings were held at the Imperial Institute by the Anglo-Russian Literary Society, the British Women's Emigration Association, the Colonial Nursing Association, the London Needlework Guild, the Women's Indian Study Association, and the Bureau of Universities of the British Empire.

Temporary office accommodation was provided on the Mezzanine Floor for the Universities Bureau of the British Empire.

The Seventeenth International Congress of Medicine were given accommodation in the rooms of the Imperial Institute for members of the Congress from the Overseas Dominions during their meeting in August 1913.

A series of afternoon Receptions was held by members of the Council of the British Women's Emigration Association for the purpose of meeting people interested in questions of emigration affecting women.

A portion of the Upper Central Gallery was placed at the disposal of the Exhibitions Branch of the Board of Trade for the purposes of inspecting and packing exhibits for the British Arts and Crafts Section of the Ghent International Exhibition, and again later in the year for the purpose of redistributing the exhibits returned from the Exhibition.

A portion of the Upper Central Gallery was lent to the City and Guilds of London Institute for the examination and display of the work executed by the candidates at the Institute's technological examinations throughout the Empire.

A bust, by Mr. F. W. Doyle Jones, of Dr. Cawas Lalcaca, who met his death on the occasion of the assassination of Sir Curzon Wyllie at the Imperial Institute in July 1909, was placed on the stairs of the Vestibule of the Jehanghier Hall. The cost of the bust was met from funds raised by public subscription in England and India, and the bust was presented to the Imperial Institute by the Memorial Committee. The bust was unveiled by Lord George Hamilton in the presence of a large gathering.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page:—

ANNUAL.

No.	Colony, &c.	Year.
782	Southern Nigeria	1912
783	Jamaica	1912-1913
784	British Honduras	1912
785	Northern Nigeria	,,
786	Malta	1912-1913
787	Uganda	,,
788	Mauritius	1912
789	Straits Settlements	,,
790	Trinidad and Tobago	1912-1913
791	East Africa Protectorate	,,
792	Grenada	1912
793	Leeward Islands	1912–1913
794	St. Lucia	,,
795	St. Vincent	,,
796	Bermuda	1912
797	Ceylon	,,
798	Gibraltar	1913
799	St. Helena	,,
800	Turks and Caicos Islands	,,
801	Seychelles	,,
802	Ceylon	,,
803	Bermuda	,,
804	Weihaiwei	,,
805	Gambia	,,
806	Gold Coast	,,
807	Northern Territories of the Gold Coast	,,
808	Sierra Leone	,,
809	Bahamas	1913–1914
810	Cayman Islands	1912–1913
811	Fiji	1913
812	Ashanti	,,
813	Basutoland	1913–1914
814	Hong Kong	1913
815	Bechuanaland Protectorate	1913–1914

MISCELLANEOUS.

No.	Colony, &c.	Subject.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments, &c.
85	Southern Nigeria	Mineral Survey, 1911.
86	Southern Nigeria	Mineral Survey, 1912.
87	Ceylon	Mineral Survey.
88	Imperial Institute	Oils, Oil Seeds, &c.
89	Nigeria	Mineral Survey, 1913.

COLONIAL REPORTS—ANNUAL.

No. 882.

REPORT, BY THE DIRECTOR, ON THE WORK OF THE IMPERIAL INSTITUTE, 1914.

(For Report for 1913 see No. 816 [Cd. 7622–7] of 1914.)

Presented to both Houses of Parliament by Command of His Majesty.
April, 1916.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
By BARCLAY AND FRY, LTD., THE GROVE, SOUTHWARK STREET, S.E.

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No. 882.

IMPERIAL INSTITUTE, 1914.

(For Report for 1913 see No. 816 [Cd. 7622-7] of 1914.)

NOTE.—That Report includes a Prefatory Statement, with list of Advisory Committee, &c.

REPORT ON THE WORK OF THE IMPERIAL INSTITUTE IN 1914. BY PROFESSOR WYNDHAM R. DUNSTAN, C.M.G., M.A., LL.D., F.R.S., *Director*.

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INTRODUCTION.

This report relates to the work carried out during the year 1914 in the several Departments of the Imperial Institute. The following paragraphs give a general account of the operations of these Departments.

Scientific and Technical Research Department.—The principal work of this Department, consisting in the investigation of new or little-known natural resources of the Empire, and especially of the Colonies and India, with the object of ascertaining their suitability for industrial utilisation, is chiefly initiated by the Home and Colonial Governments and the Government of India. Reference to the more important materials examined in 1914 is made later in this report; in most cases, the products were investigated in the laboratories and subsequently submitted to manufacturers and commercial experts for technical trial and valuation. Expert assistance of this kind was generously afforded, although during the latter part of the year many of the firms consulted were seriously handicapped by shortage of labour and other difficulties caused by the war. Machinery has been provided for conducting vulcanisation tests with rubber and for determining the mechanical properties of vulcanised rubber (see p. 9). During 1914, the installation of a timber-testing workshop was commenced, but the construction of the plant has been delayed by difficulties arising out of the war.

In addition to the work carried out on behalf of the British, Colonial and Indian Governments, requests have been received from manufacturers in the United Kingdom and from producers and others abroad for assistance of a similar kind and an arrangement has now been made with the sanction of the Secretary of State for the Colonies whereby, in certain cases, investigations are undertaken for firms or private persons in any part of the Empire on payment of appropriate charges.

Mineral Surveys, under the supervision of the Director of the Imperial Institute and conducted by Surveyors selected by him, were in progress during 1914 in Ceylon, the Gwalior State of Central India, and the Mozambique Company's Territory in Portuguese East Africa. The various specimens collected were examined at the Imperial Institute with a view to the determination of their composition and commercial value.

The number of reports completed by the Scientific and Technical Research Department in 1914 was 400, and 103 investigations were in progress at the end of the year.

Specimens of the chief products (animal, vegetable, and mineral) examined during the year have been placed on exhibition in the Reference Sample Room.

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Technical Information Bureau.—The work of the Scientific and Technical Research Department has hitherto included investigations and enquiries, the former relating to the experimental work on products and therefore to the creation of new information, whereas enquiries involve the collection and critical collation of existing information. In recent years, however, the number of enquiries has increased so much that it has been necessary to form a separate organisation for dealing with them. This new organisation is the Technical Information Bureau which was started in October, 1914, fortunately in time to deal with the mass of enquiries which the outbreak of war brought in its train. The number of these special enquiries has been so great that it has been impossible for the small staff to deal with them, and it has been necessary at times to detach other members of the staff of the Imperial Institute from other work to give assistance. The situation has been further complicated by the fact that a number of the technical members of the staff joined His Majesty's Forces. In spite of these difficulties all the enquiries have been promptly dealt with, thanks to the loyalty and strenuous exertions of the staff.

It may be of interest to mention the nature of the enquiries which have been dealt with as the result of the outbreak of the war. By far the most important have been those relating to the disposal in this country of Colonial and Indian materials which formerly went to Germany and Austria, such as palm kernels, copra, ground nuts, wattle bark, etc. The Institute has issued special circulars to British manufacturers descriptive of these products, calling attention to the possibilities they offer for new industries. This action has been most successful.

Another series of enquiries was received from British manufacturers who had depended on German sources for supplies of raw and partially manufactured materials, apparatus and plant. In many cases it proved most difficult to find at once new British sources of supply, and certain problems, particularly that of the supply of potash salts to glass manufacturers are still unsolved, but in most cases it was possible to put the enquirers into touch with existing British sources of supply, and in others to induce British firms to start the manufacture required.

A further series of enquiries was received from British manufacturers who had experienced technical difficulties in new branches of manufacture which they had undertaken. In many of these cases it was possible to suggest suitable means of overcoming the difficulties.

Much of this work is still in progress and is the subject of correspondence with the firms concerned, and it is hoped that in next year's report it may be possible to report further progress in overcoming the serious difficulties which beset the Colonial producer and the British manufacturer on the outbreak of war, especially so far as the export and utilisation of Colonial and Indian raw materials are concerned..

As an example of the demands made on the staff by these special enquiries caused by the war, it may be mentioned that the total number

of enquiries received and answered during 1914 was 977; of these, 328 were received during the last three months of the year. The total number of special technical circulars distributed to British firms was 1,067.

Public Exhibition Galleries.—The collections of economic products illustrating the resources of the Dominions, Colonies, and India have been increased by the addition of new exhibits to the various courts. A special endeavour has been made to enhance their educational value by means of statistical and economic maps and diagrams, illustrating the production and trade of each part of the Empire, which are constantly revised and kept up to date. Parties from schools are frequently conducted through the courts by the Technical Superintendents who explain the exhibits. The London County Council have shown their appreciation of these educational demonstrations. The Ceylon Pavilion, decorated in Kandyan style and containing pictures illustrative of the tea industry of Ceylon and exhibits of native industrial art, was opened to the public in June, 1914; it forms an interesting addition to the Public Exhibition Galleries (see page 10).

The Central Stand for publications and the Enquiry Office have been maintained in the main gallery to facilitate the supply of information and the distribution of literature relating to the commerce and industries of the principal British Possessions and also to emigration.

The number of ordinary visitors to the exhibition galleries during 1914 was 185,660. The number of publications distributed to enquirers at the Central Stand was 11,916.

Library, Reading Rooms, and Map Room.—The library and reading rooms are regularly supplied with the more important official publications as well as with many of the principal newspapers and technical periodicals from all parts of the British Empire and from certain foreign countries. During 1914, a scheme of rearrangement and extension of the library was undertaken with the double object of rendering it more comprehensive and of utilising the space to the fullest advantage. The existing sections of the library were thoroughly overhauled and many new and important works added. This work is still in progress. The map room, which contains a large and valuable collection of maps of the Dominions, Colonies, and India, has been considerably added to.

The additions to the library during the year number 1,735 volumes and 26,712 newspapers and periodicals.

Publications.—Reference to the quarterly "Bulletin of the Imperial Institute" and a list of the various publications issued during 1914 will be found in the Appendix (p. 31).

Tropical African Services Course.—Courses of instruction in certain specified subjects are given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction in the subject of Tropical Economic Products is given by a member of the staff of the Imperial Institute. The 18th, 19th, and 20th sessions were held during 1914.

International Congress of Tropical Agriculture.—This Congress was held at the Imperial Institute from the 23rd to 30th June, 1914, under the auspices of the International Association for Tropical Agriculture, and was attended by delegates from all parts of the world. The opening address was delivered by the President, Professor W. R. Dunstan, C.M.G., LL.D., F.R.S., and various subjects were discussed and papers read relating to questions connected with tropical agriculture and the development and utilisation of natural resources, especially those of tropical countries. The Proceedings of the Congress have now been published and the Transactions are in the press.

REPORT ON OPERATIONS IN 1914.

In the following pages, reference is made to the chief operations of the Imperial Institute in 1914 by means of a separate section for each part of the Empire. Each section is sub-divided into three portions—Investigations, Enquiries, and Exhibits. The "Investigations" refer to the work of the Scientific and Technical Research Department, the "Enquiries" to the work of the Technical Information Bureau, and the "Exhibits" to the work of the Public Exhibition Galleries.

Most of the materials referred to were received from Departments of the Colonial and Indian Governments.

India.

Investigations.—The specimens accompanying the third and fourth reports of the Gwalior Mineral Survey were examined and a report forwarded to the Government of that State; the specimens accompanying the fifth report were under examination at the close of the year. Among the more interesting Indian minerals examined were samples of Gwalior mica, of the ruby tinted muscovite variety, which were well trimmed and in good condition, and approached in appearance the well-known Bengal ruby mica. Commercial experts reported that under normal conditions they would find a ready sale in the London market. It was suggested that a trial shipment of this mica should be forwarded to London, and recommendations were made as to the best methods of trimming and packing the mica.

A sample of a green mineral pigment from Gwalior proved to be similar to the "terre verte" of Cyprus, previously examined and valued at the Imperial Institute.

Samples representing thirteen different varieties of cotton grown on the experimental farm at Akola, Berar, were examined. Most of them were rather too short in staple, coarse and rough, to be readily saleable in the Liverpool market, but three of them represented a style of cotton for which there is generally a good demand.

In this connection it may be mentioned that at the International Cotton and Fibres Exhibition which was held in London in the summer of 1914 under the presidency of Professor Dunstan, Director of the Imperial Institute, a silver trophy was offered by the President for the best sample of British-grown cotton produced on a large scale. A number of competitors sent samples, and the award was made to the Akola farm for samples of Indian-grown Buri cotton.

Other Indian fibres which were dealt with during the year were plantain, jute, Sida, *Urena lobata*, Ak (*Calotropis* sp.), and *Sterculia* sp.

Two samples of Castilloa rubber, one from male and the other from female trees grown in the Bassein Botanical Garden were examined. The former contained 81·6 per cent. of caoutchouc and 12·4 per cent. of resin, expressed on the dry rubber, and showed fairly good physical properties. The other sample was less satisfactory in physical properties, contained only 60·9 per cent. of caoutchouc, and as much as 34·3 per cent. of resin, expressed on the dry rubber.

The oil and the residual cake obtained from the seeds of *Schleichera trijuga* were examined. The oil contained traces of prussic acid and would therefore not be suitable for edible purposes, though it could be used in admixture with other fatty materials for soap making; the cake also yielded prussic acid and was therefore unsuitable for use as a feeding stuff; it had only a low manurial value.

A trial consignment of sandalwood from Coorg was sold through brokers in London, and realised £80 per ton.

Work was continued on the question of improving the quality of the Indian barley imported into the United Kingdom for malting purposes (cf. Annual Report for 1913 [Cd. 7622–7], p. 36), in association with expert referees, and the results of analyses of thirty-one samples of barley from the Punjab were forwarded to India.

Twenty-three commercial samples of maize from various parts of the world, as marketed in London, were supplied to the Department of Agriculture, Burma, for trial cultivation.

A report was made on "White Burley" tobacco grown at the Nadiad Government Farm, Bombay. The tobacco appeared to have been well grown and prepared, but it burned badly and the composition of its ash was unsatisfactory. It could be used for blending with other tobaccos in the manufacture of cheap smoking mixtures, but would probably not command more than 3½*d.* to 4*d.* per lb. in London.

At the request of the Indian Department of Forests an attempt was made to find a market for Burmese black lacque[r] ("thitsi.") Most of the firms consulted were of opinion that the [m]anufacture of lacquer ware is not likely to develop largely in the United Kingdom. Certain firms engaged in the production of such ware were of opinion that this material could be used in place of the Chinese lacquer.

A report on the oleo-resin (crude turpentine) of *Pinus longifolia* was furnished to the Forest Chemist, Dehra Dun.

Information was supplied to the Divisional Forest Officer, Travancore, on the results of therapeutical trials with the oleo-resin of *Hardwickia pinnata*.

The export and marketing of Indian opium has been the subject of correspondence with the India Office, and a memorandum on the subject was forwarded to the Indian Government.

Two samples of flower heads of *Artemisia* spp. and one of *Tanacetum* sp. were examined for santonin, which was found to be absent from all the specimens.

The question of the exploitation of the mangrove forests of Arakan was dealt with for the Indian Forest Department with a view to inducing British firms to install plant there for mangrove cutch manufacture.

A number of other Indian plant products were dealt with, the following being amongst the more important: Cardamom fruits, chaulmoogra oil, Dhupa seeds (*Vateria indica*), Nahar seeds (*Mesua ferrea*), and mango pulp.

Materials from India that were under investigation at the close of the year included samples of native beans and of Madagascar beans from Burma, "turpentine oil" and resin from *Boswellia serrata*, vetiver roots, deodar oil, opium, aconites and *Schleichera trijuga* seeds.

Enquiries.—A large number of enquiries relating to Indian products were dealt with. Information was furnished to the Government of Madras regarding the market for sandalwood and the market conditions for various Indian products, the trade in which was adversely affected by the war, including ground nuts, hides and skins, coir rope and matting, palmyra fibre, senna, pepper, and lac. Information was also supplied to Government officials on beeswax, the deodorisation of fish oils, and the hydrogenation of oils. Another important subject which occupied the attention of the Bureau was the antiseptic thymol, the manufacture of which had been practically confined to Germany, notwithstanding the fact that ajowan seeds, the oil from which is almost the sole source of commercial thymol, are produced entirely in India. No further supplies of thymol being forthcoming from Germany owing to the war, the price had increased almost eight-fold in September, 1914. The Technical Information Bureau has supplied information as to the method of preparation of thymol to several British firms contemplating its manufacture, and has placed them in communication with Indian exporters of the seed. There is reason to hope that the United Kingdom may now become the chief centre for the manufacture of this antiseptic.

Among the other subjects of enquiries relating to India dealt with by the Technical Information Bureau were monazite sand, ground nuts, mowra oil, safflower oil, fish oils, Calotropis floss, and bristles for brush-making. Special work was carried out in connection with Indian copra on the same lines as in the case of the Ceylon product (see pages 9–10).

Exhibits.—The arrangement of a number of the larger groups of economic products displayed in the East Gallery of the Indian Section of the Public Exhibition Galleries, notably the gums and resins, oils and oil-seeds, and drugs, has been improved, and new labels added. A coloured diagram showing the quantities of tea annually exported from the principal tea-producing countries of the world has been prepared. The new materials placed on exhibition during the year include cottons, Burmese timbers, Indian condiments, minerals from

Gwalior, examples of Chanderi muslins, a collection of painted boxes from Gwalior and a modern Gwalior carpet. Photographs obtained in India by the Director of the Imperial Institute have been hung in the Pavilion, and duplicates of the photographs in the Madras Museum, illustrating crops and native crafts, have also been received. A number of silver and silver-gilt caskets, lent by Their Majesties the King and Queen, have been added to the Royal presents exhibited in the Indian Pavilion.

Specimens of Indian economic products were supplied to a number of applicants, and collections of Indian materials were sent to various educational institutions, including the Hong Kong University.

A number of school parties visited the Section under the guidance of the Technical Superintendent.

The Director of the Imperial Institute visited the principal centres of agricultural and commercial production in India in the early part of 1914.

CEYLON.

Investigations.—A large number of mineral specimens accompanying interim reports from the officers of the Ceylon Mineral Survey were examined, and reports on the results forwarded to Ceylon. Further specimens from the Survey were being examined at the end of the year.

A sample of Ceylon coca leaves of Truxillo type contained 0·67 per cent. of ether-soluble alkaloids, and was valued at about 4*d.* per lb. in London, *ex* warehouse (January, 1914). The leaves of *Adhatoda vasica* were under examination at the close of the year.

Seeds of " wild croton " (*Jatropha glandulifera*) were found to yield 43·8 per cent. of oil, similar in type to that furnished by the better known seeds of *Jatropha Curcas.*

A report was furnished on samples of cigars made from native-grown Jaffna tobacco, and a sample of tobacco was under investigation at the end of the year.

As indicated in the Report for 1913 a joint scheme of rubber research has been inaugurated by the Rubber Research Committee of Ceylon and the Imperial Institute.

In connection with that scheme a rubber-testing laboratory has been installed at the Imperial Institute and this was fully described and illustrated in the " Bulletin of the Imperial Institute " (Vol. xii. (1914), No. 1, p. 76), to which reference should be made for details.

Considerable progress was made with this scheme of work in 1914, and a number of interesting results were obtained and reported to Ceylon.

Enquiries.—The most important enquiry dealt with for Ceylon was the question of finding a market for the large quantity of copra which that Colony used to export to Germany and Austria-Hungary. Notices were issued to the Press and a circular on new markets for copra was distributed widely to manufacturers, merchants, and others. Many firms in the United Kingdom were put into communication with Ceylon exporters, and several oil-mills in this country are now engaged

in the manufacture of coconut oil and cake. That this action was successful is indicated by the fact that the shipments of copra from Ceylon to the United Kingdom during the last five months of 1914 amounted to 28,000 tons, as against 75 tons during the whole of 1913. (Similar action was taken with reference to the copra industries of India and the Federated Malay States.)

Among other Ceylon products which were the subjects of enquiries dealt with during the year were thorium minerals, kapok, tea, coffee, rubber, rubber-seed oil, tobacco, coca leaves, and the manufacture of acetic acid for the coagulation of rubber latex.

Exhibits.—The work done in the Ceylon Section of the Public Exhibition Galleries during the year has been chiefly concerned with the decoration and arrangement of the new Ceylon Pavilion, which was opened on the occasion of the reception, by the Secretary of State for the Colonies, of the delegates to the Third International Congress of Tropical Agriculture, held on the 23rd June, 1914. Ceylon tea was served daily during the summer months. The exhibits arranged in the Pavilion include a collection of Sinhalese art-ware and the Fox-Pitt loan collection of water colour sketches transferred from the Ceylon Court; a number of antique Kandyan lamps and other examples of native art work, obtained in Ceylon by the Director of the Imperial Institute; a collection of coloured drawings of the fish of Ceylon; photographs of the Royal Botanic Gardens, Peradeniya; and coloured transparencies illustrating the tea industry. A large native painting on cloth has been mounted to form a dividing screen for the Pavilion.

New exhibits received for the Court comprise desiccated coconut and other coconut palm products, cocoa, cotton, fibres, spices, plumbago, and photographs. Samples of palm sugars, beeswax, sedges used in mat-making, and a carved satin-wood bowl have also been received.

Straits Settlements and Federated Malay States.

Investigations.—The nuts of *Canarium commune* and *C. rufum*, which have been suggested as almond substitutes, were examined. The kernels of both species have high food values, being especially rich in fat, of which they contain 72·3 and 70·5 per cent. respectively. The proportion of shell to kernel is however high, and the shell is hard and difficult to break.

At the close of the year camphor oil was under investigation.

Enquiries.—Information was supplied on the subject of rattan canes. Efforts were made to create a larger market in the United Kingdom for copra, and the names of shippers from the Federated Malay States were given to a number of enquirers. Reference to this work has been made already in the section on Ceylon.

Exhibits.—The readjustment of space necessitated by the refitting of the British Malaya Court during 1913 has been completed; the Court now occupies space at the north end of the East Gallery and at the east end of the North Gallery. Two coloured diagrams illustrating the export of rubber and tin have been prepared. The new

exhibits received included tapioca, sago, coffee, gambier, sugar, spices, rattans, and timbers, in addition to photographs. It is hoped to add further samples of Straits Settlements produce and photographs of Singapore Harbour and of towns and buildings in the Straits Settlements.

Hong Kong.

Investigations.—A report was furnished on a sample of camphor oil. The oil differed considerably from the Japanese white and red camphor oils of commerce. Its value in European markets would probably be about 27*s.* 6*d.* per cwt. (May, 1914).

Enquiries.—Information on bristles for brush-making was supplied by the Technical Information Bureau.

Exhibits.—A large scale map of the Colony has been framed and hung in the Hong Kong Court. New printed labels have been added and existing labels revised. Samples of Chinese products exhibited in the Court and information regarding them have been supplied to enquirers.

Nigeria.

Investigations.—The examination of the specimens collected in the Southern Provinces by the mineral survey was completed, and the Report on the Work of the Survey during 1913 was issued by the Colonial Office in the Miscellaneous Series of Colonial Reports (No. 89) [Cd. 7567]. In addition, a second special report on the Udi-Okwoga coalfield was forwarded to the Colonial Office.

A specimen of impure galena from the Ogoja district was found to contain 40·94 per cent. of lead, and 5 dwts. of silver per ton, with traces of copper and zinc. The quantity of silver present was too small to enhance the value of the ore, and it appeared doubtful whether ore of this quality could be profitably exported. Previous samples of lead ores from the Ogoja district have however contained much more silver than the present specimen, and an examination of the district by experts was recommended in order to determine the extent of the deposits and the average quality of the ore.

Specimens of schist, kaolin, ferruginous clay, ironstone, sand and fossils were also examined, and at the close of the year specimens of various other minerals were under investigation.

Two samples of soil from the Government cotton farm at Maigana, near Zaria, and two from the Aguji farm, both in the Northern Provinces, and three samples from the Experiment Station at Ibadan were examined, and suggestions were made for their improvement.

Three samples of cotton grown at the Maigana cotton farm during the season 1913–1914 were of fairly good strength and of good quality, and consignments of similar cotton would be readily saleable. Reports were also furnished on four samples of indigenous cottons. Three of these were of good, useful quality but the fourth was very rough and therefore less valuable.

A sample of wild silk from the Sokoto Province consisted of cocoon colonies, resembling specimens of *Anaphe Moloneyi* from Nigeria previously examined at the Imperial Institute.

A report was furnished on six samples of millet and five of guinea corn plants from Lokoja; the samples represented the plants at various stages of growth and were examined in continuation of an investigation into the occurrence of cyanogenetic glucosides in these cereal grasses. The results of the investigation have been published in a paper by Dr. J. R. Furlong of the Scientific and Technical Research Department Staff (*The Analyst*, 1914, Vol. 39, p. 430).

In continuation of the investigation of methods of preventing the attack of West African maize by weevils, samples of maize treated by various methods in Nigeria were examined and reported on.

A trial sale consignment of three grades of Kol-kol gum (*Acacia Senegal*) from the Northern Provinces was received. The gum was of very good quality as regards colour, solubility, and adhesive properties, the three grades differing mainly in the size of the fragments. The gum was sold through merchants in London in one lot at 30*s*. per cwt. Recommendations were made as to the better preparation and packing of the gum for the market.

A report was also furnished on a number of gums and herbarium specimens of gum-yielding trees, in connection with the general question of determining the identity of the gum-yielding species of Nigeria.

Samples of cocoa, prepared experimentally in Nigeria to test the relative advantages of artificial drying and sun drying, were examined and valued. All the samples were of very good quality and of normal composition. There was little difference between the cocoas dried by the two methods. The results, which on the whole were in favour of at least partial sun-drying, are therefore not finally conclusive. Two further samples, prepared by heating the beans in a rotary dryer without previous fermentation, exhibited the usual characters of unfermented cocoa. They were of good quality for this type of cocoa but would not realise such good prices as the fermented beans.

Amongst other plants and plant products from Nigeria dealt with during the year were: Para rubber, palm kernels, "Sese" beans, "Girigiri" bean seeds (probably *Vigna* sp.), the "Agwa" plant (*Strophanthus hispidus*), the "Garmain" plant (*Sida cordifolia*), plants used in native medicine, and a fungus attacking Para rubber trees.

Material from Nigeria under examination at the end of the year included rubber, rubber-seed oil, palm nut shells, "Gigeya" plant and ostrich feathers.

Enquiries.—Among the Nigerian products which were the subjects of enquiries dealt with were palm oil, palm kernels, copra and coconut oil, the occurrence of so-called "potash" salts in the Protectorate, grain-drying and the destruction of weevils in grain.

In view of the closing of the German markets owing to the war, an effort was made to find an outlet for British West African palm kernels. The attention of oil-seed crushers and others in the United Kingdom was directed to this matter and a statement giving full particulars of the German palm kernel industry was published in the "Bulletin of the Imperial Institute," Vol. xii. (1914), No. 3, p. 458. As a result, the manufacture of palm kernel oil and cake is now being carried on by several oil mills in the United Kingdom. Further work on this subject was in active progress at the end of the year.

Exhibits.—Work during the year has been mainly concerned with the amalgamation of the Southern and Northern Nigeria Courts, and the incorporation of new exhibits. The latter comprise oil-palm products, shea butter, ground nuts, rubbers, cotton, fibres, tsamia silk, cocoa, coffee, native foodstuffs, gums, hides and skins. A large picture of Port Harcourt has been glazed and hung in the Court. At the request of the Nigerian Government a representative collection of British products manufactured wholly or partly from Nigerian produce was prepared for exhibition in the Nigerian section of the Fourth International Rubber and Allied Industries Exhibition. Most of these exhibits, and also exhibits of Nigerian produce, were transferred to the Imperial Institute at the conclusion of the Exhibition and have been incorporated in the Court as far as possible. The utility and appearance of the Court have been much enhanced by the new exhibits and equipment received.

In view of the importance attached to the question of finding a market for the large quantities of palm kernels hitherto exported to Germany (see above) a special exhibit illustrating the vegetable oil resources of Nigeria was arranged in the centre of the Court, and has been of great service to enquirers.

Gold Coast.

Investigations.—A sample of smoked Para rubber prepared in biscuit form from trees 13 years old growing at Aburi was examined. The dry rubber contained 94·1 per cent. of caoutchouc and its physical properties were very satisfactory. A sample of smoked Funtumia rubber, prepared from trees about nine years old growing at Aburi, consisted of thin, irregular, brown biscuits. The dry rubber contained only 81·7 per cent. of caoutchouc, but the physical properties were very good.

Two samples of beans were received during the year and were identified at the Royal Botanic Gardens, Kew, as *Canavalia obtusifolia* and *C. ensiformis* respectively. Both beans were shown by analysis to have a fairly high food value and would probably be of value as a feeding stuff for cattle.

Two specimens of copal from the Dunkwa district consisted of large pieces of clean, hard, transparent resin, one being of a pale yellow tint and the other slightly darker. They yielded varnishes of good quality and were similar to samples of Gold Coast copal previously examined at the Imperial Institute.

Among other products from the Gold Coast dealt with during the year were cocoa-pod fibre, the oil-seeds "Abeko" or "Abaku" nuts (*Dumoria Heckeli*) and "Owere" seeds (*Monodora Myristica*).

Materials from the Gold Coast under investigation at the end of the year included an extensive series of minerals collected by the Geological Survey of the Gold Coast, a further sample of "Owere" seed, and *Raphia vinifera* fruits.

Enquiries.—Information was supplied in answer to a number of enquiries on various Gold Coast products, including palm oil, palm kernels, palm kernel oil, copra, and coconut oil. A statement referring to the work done in connection with palm kernels is given on page 12.

Exhibits.—Work done in the Gold Coast Court has been concerned mainly with an improvement in the arrangement of the present exhibits so far as the available show-cases will permit.

Sierra Leone.

Investigations.—Seven soils from the Agricultural Experimental Farm, Jala, were reported on. The samples included soils from the cocoa and kola plantations, from plots on which rice and ground nuts had been grown, and from bush-land. Most of the soils were deficient in lime and phosphoric acid, and appropriate manurial treatment was suggested.

A sample of soil was under examination at the end of the year, as well as roots of the " bitter leaf tree."

Enquiries.—Among subjects of interest to Sierra Leone on which information was furnished to enquirers during the year were palm oil and palm kernels. Special action was taken with reference to palm kernels. (See page 12.)

Exhibits.—Considerable improvements have been effected in the Sierra Leone Court during the year. A consignment of samples intended for the Fourth International Rubber and Allied Industries Exhibition was transferred to the Court, and these have been displayed so fa as is possible with the show cases available.

Gambia.

Enquiries.—During the year the Technical Information Bureau took action with a view to finding fresh markets for certain products from British West Africa, the disposal of which had been interfered with by the outbreak of the war (see page 4), and two of the products dealt with, viz., ground nuts and palm kernels, are largely represented in the export trade of the Gambia. As a result of this action, palm kernels, formerly chiefly exported to Germany, are now being treated on a large scale by oil-seed crushers in the United Kingdom. Similar action was also taken with reference to ground nuts, which form the chief export from this Colony. The work on ground nuts was still in progress at the close of the year.

Exhibits.—The improvements effected in neighbouring West African Courts necessitated some re-arrangement of the Gambia exhibits. Small stands and other fittings have been added and improved descriptive labels for the products printed.

Egypt.

Investigations.—A large number of samples of cotton were examined and reported on during the year. Ten samples representing earlier and later pickings of different cottons, were of special interest. They were all of satisfactory quality, though the later pickings of each cotton were somewhat inferior to the earlier pickings.

Twenty-two specimens, representing the results of selection experiments, and fifty-six obtained in a series of manurial experiments, were also examined and reported on.

Three samples of Sisal hemp were of excellent quality, being comparable with the highest grades of commercial Sisal hemp, and represented fibre which would be readily saleable in large quantities.

Three samples of wheat were of qualities suitable for this market.

A report was furnished on the volatile oil obtained from *Santolina Chamaecyparissus*. Specimens of Egyptian henbane (*Hyoscyamus muticus*) and stramonium were under examination at the end of the year.

Enquiries.—Information was supplied as to market conditions in the United Kingdom for the following Egyptian products:—Sisal hemp, wheat, maize, barley, rice, lentils, sesame, ground nuts, and apricot kernels.

A great deal of attention has also been given to the question of creating a market in the United Kingdom for a number of important Egyptian drugs, the trade in which had been allowed to drift into the hands of German merchants before the war. Among these are senna and Egyptian henbane. From the latter the alkaloids atropine and hyoscyamine are prepared. British chemical manufacturers have now been placed in touch with Egyptian exporters of henbane, and it is anticipated that the manufacture of these alkaloids, hitherto mostly carried on in Germany, will be extended in the United Kingdom.

A number of other matters relating to Egypt were dealt with, among which drugs and indigo may be mentioned.

Anglo-Egyptian Sudan.

Investigations.—Fifty-one samples of different varieties of Sudan cotton were examined. The cottons, which represented both Egyptian and American varieties, were all of good quality.

A sample of kapok (*Eriodendron anfractuosum*) consisted of clean, lustrous floss, comparing favourably with a standard commercial sample of Java kapok. A specimen of Ushar floss (*Calotropis procera*) was examined and submitted to commercial experts, who reported that it should be possible to dispose of consignments at satisfactory prices. Information was also supplied as to possible uses for this material.

Leaves of the dom palm (*Hyphaene thebaica*) were examined and it was found that a very satisfactory paper could be made from them. The leaves were also tried by a manufacturer as a material for the production of braiding for straw hats; he reported that they were satisfactory for that purpose, but that the manufacture of braid from them would only be practicable if labour and other conditions would allow of its being undertaken as a local industry in the Sudan. Enquiries on this point are still in progress.

A trial sale consignment of "Sant" pods (*Acacia arabica*) was sold at £7 per ton (February, 1914) and there is little doubt that a regular market could be found in the United Kingdom for this product as a tanning material.

A trial consignment of Ceara and Landolphia rubbers was sold through brokers at 1*s.* 9½*d.* per lb. with fine hard Para at 3*s.* 0½*d.*, and first quality plantation Para at 2*s.* 4¾*d.* per lb.

Other materials from the Sudan dealt with during the year included sugar-cane, frankincense, and pearl shells; a supply of Sudan pearls was being dealt with at the close of the year, and volatile oil from *Cymbopogon senaarensis* grass was being fully examined.

Enquiries.—Information was supplied to enquirers regarding a number of Sudan products, including senna, gums, sant pods and other tanning materials, ground nuts, dura, hides, and skins. The attention of British merchants and manufacturers was drawn, by means of a notice issued to the press, to a number of Sudan products capable of replacing similar materials, the supply of which from the usual sources had become restricted owing to the war. The interest of a number of firms in the United Kingdom was aroused and several, at their request, were placed in communication with exporters in the Sudan. It is understood that this action has already resulted in increased trade in Sudan produce with the United Kingdom.

Exhibits.—The re-organisation and development of the Sudan Court has been proceeded with. A series of photographic transparencies has been fitted in the windows of the Court and a number of large photographic pictures framed and glazed have been added. The scale-model of Port Sudan has been completed and placed in the centre of the Court.

The Sudan Government exhibit at the Fourth Rubber and Allied Industries Exhibition has been installed in the Court.

The glazed screen carrying the plans of Khartoum and Omdurman was lent to the Victoria League for display at a Town Planning Exhibition held at the Imperial Institute during May. A collection of typical Sudan products was prepared for exhibition at the Bristol International Exhibition, 1914.

Somaliland.

Investigations.—Among the Somaliland products examined were crude petroleum, a series of minerals, specimens of *Calotropis procera* and *Acacia arabica*, gum from the last-named plant, and bast fibre from the Galol acacia.

At the close of the year samples of salt were under examination.

Enquiries.—Information was supplied regarding the cultivation of date palms.

Exhibits.—A case containing a number of samples of Somaliland produce was in course of arrangement at the end of the year.

Uganda.

Investigations.—Five samples of unginned improved American Upland cottons, grown at the Government Experimental Farm, Kadunguru, were of very promising quality, being all clean, of pale cream colour, lustrous and very soft.

A sample of fibre of the jute type was of short staple and comparatively low value. Information was supplied as to the preparation of fibre of this type. Two samples of other fibres and of ropes made from them were also examined.

A sample of tea grown and prepared on the Government Plantation at Kampala was found to be rich in caffeine, tannin, and extractive matter, and in that respect to resemble Indian rather than China tea. It yielded a liquor of fair strength, but of very light colour and too thin to attract most buyers in London. Two better prepared samples were received later in the year. These yielded liquors of better colour though still showing lack of strength.

Other products from Uganda dealt with during the year were a supposed wild coffee, lac produced by the scale insect, *Tachardia decorella*, a supposed gum, native drugs, and fungoid diseases of rubber and cocoa trees.

Enquiries.—Among the Uganda products regarding which enquiries were answered were coffee, cocoa, senna, tobacco, and "elephant grass."

Exhibits.—In the Uganda Court a large scale map and statistical board have been placed on exhibition. New descriptive labels have been added and an improvement effected in the general arrangement of the exhibits.

East Africa Protectorate.

Investigations.—Twenty-four samples of soils from Jubaland were examined and reported on. Recommendations were made as to suitable manuring and treatment, and information was supplied relating to irrigation and to the growing of various crops on the lands represented by the soils.

Four samples of flax from the Experimental Farm, Kabete, were reported on. One was of good quality, closely resembling the standard European varieties in chemical composition and behaviour. The other three samples represented fibre from straw—(1) not laid by rain, (2) not badly laid by rain, and (3) badly laid by rain. All three were regarded as superior to Russian flaxes, and more comparable with the Belgian kinds.

Nine samples of tobacco, of which seven were grown at Kabete and two at Kibwezi, were examined. They were all of promising quality for the product of a first experiment. Seven other samples of tobacco, grown from South African seed, were examined and found to be mostly of poor burning quality, and not of a type to suit this market.

Four samples of black wattle bark received from the Acting Conservator of Forests, Nairobi, were somewhat thin and contained from 28·6 to 40·4 per cent. of tannin.

Other subjects dealt with during the year were: Caravonica cotton, beans, citrus fruit, coffee, and scented roots. An investigation of the seeds of *Croton Elliottianus* was in progress at the end of the year.

Enquiries.—Information was supplied to enquirers on the subjects of citrus cultivation, and conditions of land sales in the Protectorate.

Exhibits.—A collection of the products of the Protectorate has been received from the Fourth International Rubber and Allied Industries Exhibition, but a portion only of the new material has been placed on exhibition owing to want of show-cases. A new small scale map of the Protectorate has been added.

Zanzibar and Pemba.

Investigations.—Four samples of cloves of various degrees of maturity and from trees of various ages, two samples of clove stems and one of "mother-of-cloves," were examined and reported on. The cloves yielded from 17·4 to 19·2 per cent. of oil of cloves, the stems 5·9 and 6·3 per cent., and the "mother-of-cloves" (fruits) 6·5 per cent. All the samples were stated by brokers to be of good quality.

A small trial consignment of coir matting and rope made in Zanzibar was sold in London, on behalf of the Governor of Prisons.

Enquiries.—Information regarding millet in Zanzibar was supplied.

Exhibits.—The Court has been re-organised during the past year in order to accommodate the new samples available.

Nyasaland.

Investigations.—Thirty-one samples of soil from various localities in the plain between Lake Shirwa and Zomba Mountain were examined and reported on with reference to their suitability for cotton and tobacco cultivation. Four samples of tobacco soils from the Chiranga, Ntwonde, Naisi and Mlungusi estates were also examined.

A number of minerals from the Protectorate were reported on.

Seven samples of cotton were on the whole of fairly good quality but contained some weak, unripe fibre, probably as a result of having been picked before complete maturity.

Two samples of broom corn "brush" grown on the Government Farm, Zomba, were of a quality suitable for the manufacture of brooms. Recommendations were made for the better preparation of the product for this market.

Enquiries.—The question of the marketing of Nyasaland tobacco was dealt with. A large amount of special information was collected on this subject and a Conference was held at the Imperial Institute, at which a number of matters were discussed, relating to the use of Nyasaland tobacco in the United Kingdom and elsewhere, the best methods of marketing the product, dock and warehouse charges on Nyasaland tobacco, the deterioration of the tobacco through unduly long storage in warehouses, the grading and packing of the product in the Protectorate, and the improvement of the crops. A memorandum summarising the information collected by the Imperial Institute and the results of this Conference was forwarded to the Government of Nyasaland.

At the suggestion of the Imperial Institute the War Office has altered the specification for the tobacco supplied to the Army whereby tobacco of satisfactory quality grown from American seed in the British Colonies and Protectorates can be used. As a result of this work the market for Nyasaland tobacco in the United Kingdom has been extended considerably.

Exhibits.—The re-organisation of the Nyasaland Court has been completed. Cases have been arranged to illustrate the leading industries of the Colony. Photographs have been mounted and placed on exhibition. Descriptive labels have been printed for the exhibits. A large wall-map of the Protectorate is displayed.

Rhodesia.

Investigations.—Three samples of chrysotile asbestos from Southern Rhodesia were received, two from the Victoria district and one from the Belingwe district. The two former consisted of somewhat short fibre, but the third was longer. It was pointed out that the value of the material could be enhanced by hand-picking and grading.

A sample of tantalum ore from the Victoria district was examined and information as to the conditions of the market for this material was furnished.

Two samples of iron ore from Southern Rhodesia were analysed; one was of excellent quality, consisting of almost pure magnetic oxide of iron, while the other contained too high a percentage of silica to be of value as an iron ore for export. Minerals from the neighbourhood of the Kafue River were also reported on.

Information was furnished regarding Ceara rubber and a sample of "Tshizimboti rubber" was examined. The latter is the coagulated latex of *Euphorbia* sp.; it was found to contain a large proportion of resin and insoluble matter, and only 8·1 per cent. of caoutchouc expressed on the dry material, and was therefore of small value.

Three samples of tobacco were well grown and cured, and represented leaf which could be used for blending in pipe or cigarette tobacco.

A sample of ground nut kernels from Northern Rhodesia was of very good quality and yielded 44·2 per cent. of oil.

Among other Rhodesian products examined during the year were: *Canavalia obtusifolia* beans, buckwheat, chillies, the fibre-plant *Buphane disticha*, *Strophanthus* seed, papain and "Ululu" or "Uwa" plant (*Tephrosia Vogelii*).

At the close of the year a number of fibres and fibre-yielding plants were under examination, including flax, Deccan hemp (*Hibiscus cannabinus*), Sunn hemp (*Crotalaria juncea*), Mauritius hemp (*Furcraea gigantea*), and baobab fibre (*Adansonia digitata*).

Enquiries.—Information on soda alum was supplied in connection with the discovery of a deposit of that material in Northern Rhodesia. Enquiries relating to markets for ground nuts and to the treatment of scale of citrus trees were also dealt with.

Exhibits.—New labels have been added to the exhibits in the Rhodesia Court and the map brought up to date in regard to railway extensions.

Union of South Africa.

Investigations.—A specimen of crocidolite asbestos was examined, the fibres of which measured from 1¼ to 1½ inches in length, and were tough and suitable for textile use.

A sample of kaolin was submitted to analysis and technical trial. It produced satisfactory tiles, and though suitable for local use could probably not be exported in competition with Cornish clay. A further specimen of kaolin was being examined at the end of the year.

A specimen of coal from Cape Province consisted of anthracite of good quality and of high calorific value.

Samples of shale and limestone sand from the same Province were also dealt with.

A hybrid cotton grown on the Government experimental farm at Rustenburg was of excellent appearance and quality, but rather soft and not very strong.

Other products used or proposed to be used as sources of textile materials, which were dealt with during the year, included the "gift-bol" plant (*Buphane disticha*), the "milk-bosch" plant (*Asclepias fruticosa*), and a sample of silk from the Transvaal.

A sample of "Tambookie" grass was found to give a good yield of pulp, which was easily bleached to a pure white product, and yielded paper of satisfactory quality. The grass would probably be worth about £4 per ton in the United Kingdom (July, 1914), but it was considered that it would be more remunerative to convert the grass into "half-stuff" in South Africa, and either to ship this "half-stuff" to Europe or to utilise it locally in the manufacture of paper. This report, on publication in South Africa, attracted much attention, and a number of enquiries were subsequently received and dealt with regarding the cutting of the grass, preparation of "half-stuff" and paper-making generally.

A sample of papyrus grass from Zululand was also examined as a paper-making material. It produced a satisfactory paper of good strength, but would probably not realise more than about £3 per ton in the United Kingdom (July, 1914). As this price was not likely to be profitable to exporters the conversion of the grass into "half-stuff" or paper in South Africa for export was suggested.

A sample of the latex of *Euphorbia Tirucalli*, collected in Natal, contained 15·7 per cent. of caoutchouc and 82·1 per cent. of resin expressed on the dry material. Information was supplied as to the method of treating this material and as to its marketing and uses.

The leaves of *Barosma venusta* were examined, and it was found that they could not be used medicinally as a substitute for the ordinary buchu of commerce, *Barosma betulina*. The leaves yielded 2 per cent. of volatile oil, which differed in important respects from that obtained from buchu leaves. The results of the investigations were communicated to the Chemical Society of London by Dr. E. Goulding and Mr. O. D. Roberts of the Scientific and Technical Research Department Staff (Transactions of the Chemical Society, 1914, Vol. 105, p. 2613).

A sample of ginger from Natal was of good quality and was valued at about £20 per ton (May, 1914). Information was supplied, and recommendations were made, as to the better preparation of the material.

Samples of the fruit and bark of the hard pear tree (*Strychnos Henningsii*) were found to contain an alkaloid, the bark yielding 4·8 per cent., the kernels 4·0 per cent., and the husks 0·16 per cent. Further work on the alkaloid was in progress at the end of the year.

The results of an examination of Cape Slangkop (*Ornithoglossum glaucum*), which is poisonous to stock in South Africa, were summarised in a report. The poisonous constituent was isolated both from the bulbs and the leaves, and physiological trials showed it to possess a typical digitalis action.

A report was furnished on investigations carried out by Professor Adrian Brown and Mr. W. C. Till, of Birmingham University, at the request of the Imperial Institute, on the fermentative properties of the roots of *Mesembryanthemum Mahoni*.

Among other products examined were the "Ntsema" root used by natives in the preparation of the liquor called "Kali," "Rhenoster Bos" (*Elytropappus rhinocerotis*) and the fruits of the "Mopane" tree (*Copaifera Mopane*). A report was furnished on a pest attacking eucalyptus trees.

At the close of the year a number of vegetable products were under examination, including maize, banana stems, the wood of *Buxus Macowani*, the barks of *Chrysophyllum viridifolium*, *Gonioma Kamassi* and *Bersama Tysoniana*, "Sherungulu" tubers, *Urginea Burkei* bulbs, the leaves and stems of *Acokanthera venenata*, the leaves of *Dichapetalum cymosum* and the plants *Crotalaria Burkeana* and *Homeria pallida*.

Enquiries.—A memorandum was furnished to the Union Government on the manufacture of paper from maize stalks. Among other subjects on which information was supplied were: diamond deposits, ramie fibre, the use of *Hibiscus cannabinus* and *Sida rhombifolia* fibres as substitutes for jute, gambier (terra japonica) and the manufacture of tomato pulp.

Exhibits.—The new exhibits in the Union of South Africa Court, received through the Trades Commissioner in London, include maize, jiba and kaffir corn (Government standard grades), wines, wattle bark (Government standard grades), aloe fibre, beans, peas, cotton, ground nuts, fodder, sunflower seed, hemp seed, linseed, plums, pineapples, preserved fruits, jams, tinned lobster, wool, mohair, whalebone and ostrich feathers. In order to display these samples it was necessary to effect a partial re-arrangement of the Court, and owing to insufficient show-case accommodation, to withdraw from exhibition a considerable number of samples previously in the Court. The most noticeable of the new exhibits is a collection of ostrich feathers.

A new large scale map of the "Union of South Africa, showing adjacent Territories" is in preparation. The existing maps have been improved and brought up to date. Specimens of rubber and rubber-vines were lent to the Trades Commissioner for display at the Fourth International Rubber and Allied Industries Exhibition. Samples of Kelsey plums were prepared for exhibition at the office of the Trades Commissioner.

St. Helena.

A memorandum was furnished on the question of the proposed cultivation of flax and hemp on the Island; information relating to the cultivation of these plants, the preparation of the fibres, and market conditions affecting them, was supplied.

Mauritius.

Investigations.—A sample of ylang ylang oil experimentally produced in the Island was of pleasant odour, but had somewhat abnormal chemical characteristics, and would probably not command a higher price than 3*s*. to 4*s*. per ounce, with best Manila ylang ylang oil, at 12*s*. to 13*s*. per ounce.

Two samples of clove oil and three of clove leaf oil, although somewhat inferior in colour and aroma to the best clove oils distilled in the United Kingdom, were of good quality, containing a high percentage of eugenol, and would find a ready sale in Europe, for the preparation of vanillin, at a price slightly below that of the best clove oil.

Three samples of sandalwood oil were of good quality, but rather dark in colour. The oils would be readily saleable in Europe at prices somewhat below those of English distilled sandalwood oil.

A sample of the seeds of *Canarium colophania* contained kernels of high food value, but owing to the thickness and extreme hardness of the shells they are not likely to be of commercial value for export.

Advice and assistance were given relating to the purchase in London of automatic petrol gas-making plant for use in the laboratories of the Department of Agriculture, and the plant was inspected before its despatch to Mauritius.

Material from Mauritius under examination at the close of the year included camphor oils, and the seeds of *Quisqualis indica* and *Combretum comosum*.

Enquiries.—Enquiries were dealt with on the subjects of Mauritius hemp and the soil of the island.

Exhibits.—New fittings have been constructed in the Mauritius Court and the exhibits arranged to better advantage.

A large photographic album has been made to contain a series of photographs copied, at the request of the Colonial Government, from negatives sent to the Imperial Institute by the Government. The album (containing about 100 photographs) has been sent to Mauritius. A further set of the prints is exhibited in the Court.

Seychelles.

Investigations.—A head of palm fruits consisted of fruits of the ordinary thick-shelled variety, which closely resembled the "Ak-por-ro-jub" variety from Nigeria in quality (*cf.* "Bulletin of the Imperial Institute," Vol. vii. (1909), No. 4, p. 376).

A sample of ylang ylang oil from Seychelles resembled first grade Manila ylang ylang oil in chemical and physical characteristics, but its odour was pronounced by experts to be not quite so good.

Exhibits.—The arrangement of the exhibits in the Seychelles Court has been improved by the construction of new fittings; the timber specimens have been re-dressed.

Cyprus.

Investigations.—A sample of salt from the Salt Lake at Larnaca was analysed and a report furnished to the High Commissioner. A memorandum on the refining and marketing of this salt was in preparation at the close of the year.

A sample of barley, forwarded from Cyprus with a view to ascertaining its suitability for malting, was regarded by commercial experts as of good quality for that purpose. It contained a low percentage of nitrogen, which is a good feature in malting barley.

Enquiries.—Among enquiries relating to Cyprus products which were dealt with, Cyprus origanum oil may be specially mentioned. This oil contains carvacrol, which possesses antiseptic properties similar to those of thymol, and it was suggested that in view of the shortage of the latter material owing to the war, carvacrol might be prepared from the oil for use as a substitute.

Exhibits.—The exhibits received during the year for the Cyprus Court comprised carobs, olive oil, cotton and cotton yarns, soy beans, orange oil, and silk. The representation of Cyprus products in the Court has been much improved by the addition of these samples.

CANADA.

Investigations.—The investigation of the poisonous properties of *Senecio Jacobaea*, the common ragwort, tansy ragwort, or staggerwort, was continued, and a report forwarded to the Veterinary Director-General, Ottawa. The plant was stated to be the cause of a kind of hepatic cirrhosis in cattle known in Nova Scotia as "Pictou disease," and its chemical and physiological examination was of particular interest in view of the investigations carried out at the Imperial Institute on the allied plant *Senecio latifolius*, which is the cause of the similar Molteno disease in South Africa. The latter plant yielded two new poisonous alkaloids. A poisonous alkaloid, apparently distinct from either of those obtained from *S. latifolius*, has also been isolated from *S. Jacobaea*. This alkaloid has been physiologically examined by Professor Cushny of University College, London, and found to be the cause of Pictou disease. (*Cf.* Annual Reports for 1909 [Cd. 4964–30] (p. 39), 1910 [Cd. 5467–23] (p. 36), and 1911 [Cd. 6007–37] (p. 40).)

A sample of supposed amber from the shores of one of the Canadian lakes was found to be a fossil resin, distinct from amber, and possibly suitable for use as a varnish resin. Its possibilities in this direction were under investigation at the end of the year.

In addition, a number of samples of Canadian minerals were examined in the course of the year.

Enquiries.—Among the most important Canadian subjects upon which information was supplied were: Molybdenite, market conditions affecting Canadian mica, and the cultivation of medicinal plants and of flax.

Exhibits.—The Canadian Section of the Public Exhibition Galleries is now arranged in the Western Arcade and North Gallery, the two collections being connected by a spacious new bridge completed in 1913. Following upon the improvements effected during 1912–13, including the renovation of the wall-cases in the agricultural portion, the installation of a large collection of fruits, and the provision of a mahogany wall-fitting for the map of Canada, the most important item completed during 1914 has been the redecoration of the Western Arcade, in which the greater part of the Canadian Section is arranged. Samples of cigar tobacco, grown at Kelowna, B.C., have been placed on exhibition.

The Canadian exhibits in the North Gallery need re-casing, and several additions to the Canadian Section are desirable.

NEWFOUNDLAND.

Investigations.—Among the Newfoundland products examined during the year were oil shales and a number of other minerals of economic interest.

Enquiries.—Information was supplied on wood pulp manufacture, and on timbers of various kinds, in particular those suitable for pit-props and for the manufacture of matches.

Exhibits.—Work in connection with the Newfoundland Court has been chiefly concerned with the improvement in the arrangement of exhibits. The mineral collection is in process of re-arrangement and labelling; the large specimen of labradorite has been cut into two pieces, the surfaces of which have been polished.

Additional pictures and photographs have been added and new fittings provided. New labels have been printed and the large wall-map corrected; the large oil paintings occupying the north wall of the Court have been cleaned. The Court has been photographed, and framed enlargements, together with a framed photograph of the Imperial Institute, have been sent to the Colony for exhibition in the Government Museum. In view of commercial enquiries received, the Colonial Government has been asked to provide additional samples of Newfoundland timbers.

The Director of the Imperial Institute visited Newfoundland in the summer of 1914 and enquired into the mineral and other resources of the island.

WEST INDIES, INCLUDING BERMUDA AND BAHAMAS.

Investigations.—Three samples of Para rubber from Dominica were very satisfactory in chemical composition, containing 93·4 to 94·2 per cent. of caoutchouc, but were rather soft and weak.

A sample of Funtumia rubber from the same island contained only 84·6 per cent. of caoutchouc, the percentages of resin and protein being high, but it showed excellent physical properties.

Among other West Indian materials examined during the year were six minerals (Grenada), 11 samples of water (Bahamas), essential oils from *Ambrosia hispida* (Montserrat) and from ripe and unripe oranges (Dominica), agave pith and manchineel fruits (Antigua), nine samples of timbers and a specimen of sponge (Turks and Caicos Islands), and a sample of Mora wood (Trinidad). Products from the West Indies that were being dealt with at the end of the year included sugar-cane press-cake (Barbados), *Canavalia ensiformis* beans (Montserrat), banana meal (Jamaica), and "bay rush" and "unction" roots (Bahamas).

A sample of rope as used by the Government of Bermuda was examined with a view to determining the source of the fibre used in making it.

Enquiries.—Information was supplied relating to fustic and substitutes for fustic to be used as dyes for khaki, also to citrus cultivation, cohune nuts, mineral oil, sugar, sugar-cane wax, locust gum, and the wood of *Mora excelsa*.

Exhibits.—The arrangement of the Jamaica Court has been improved so far as the present exhibits and equipment allow. Mr. Frank Cundall, Secretary to the Permanent Exhibitions Committee, visited the Court and discussed plans for the re-organisation authorised by the Colonial Government. The industrial maps previously exhibited in the Court have been sent to Jamaica for revision. Samples of Jamaica produce were prepared for exhibition at the Bristol International Exhibition, 1914; a smaller collection was sent to an exhibition at Bolton.

A series of cocoa samples, prepared under varying conditions, has been received for exhibition in the Trinidad and Tobago Court. Specimens of rubber-tapping knives used for Castilloa trees have been presented by the Director of Agriculture for Trinidad.

The re-arrangement of the exhibits in the Barbados Court has afforded greater prominence to the sugar products.

Samples of St. Lucia produce were prepared for an exhibition at Bolton, and a number of photographs from the St. Lucia Court were lent to the West India Committee for use at the Fourth International Rubber and Allied Industries Exhibition. A useful series of exhibits was obtained from this exhibition, but the existing show cases do not permit of a satisfactory display of the material now available.

The new exhibits received in the Windward Islands Court comprise: Cotton, arrowroot and other starches, cocoa, ground nuts, and photographs from St. Vincent; and lime products, cocoa, cotton, sugar, arrowroot, spices, coffee, and fruits from St. Lucia.

A loan collection of produce of the Leeward Islands was prepared for exhibition at the Bristol International Exhibition, 1914. The following Presidencies were represented: Dominica, Antigua, Montserrat, St. Kitts-Nevis. Arrangements were also made for the display of products of Dominica and St. Lucia at an exhibition at Bolton. A useful series of exhibits was obtained from the Fourth International Rubber and Allied Industries Exhibition, but the limited case accommodation has prevented an adequate display of the material now available. Fittings have been made and labels added. The new exhibits include lime products, cocoa, spices, coconut products, rubbers, kola, coffee, and starches from Dominica; sugar, rum, molasses, cotton, limes, coconuts, and fruits from St. Kitts-Nevis; sugar, molasses, cotton, lime products, starches, coconut products, and oil-seeds from Antigua; lime products, cotton, cocoa, papain, and starches from Montserrat; and salt from the Virgin Islands.

British Honduras.

Investigations.—A sample of "Vagamani" nuts was identified as *Virola* sp., probably *V. surinamensis*, and information relating to the possibility of finding a commercial outlet for the nuts was supplied.

Enquiries.—Information was supplied relating to machinery for cracking cohune nuts.

Exhibits.—The exhibits received from the Fourth International Rubber and Allied Industries Exhibition necessitated the re-arrangement of the British Honduras Court; this work is in progress.

Fittings have been designed for a small timber trophy, and new labels added. The new samples received include mahogany and other timbers, chicle, sugar, rum, cocoa, cohune nuts and oil, and fibres.

Further exhibits are still required to render the Court thoroughly representative. Arrangements were made for the display of a sample of British Honduras cohune nuts at the Bristol International Exhibition, 1914, and at an exhibition at Bolton.

British Guiana.

Investigations.—Two samples of Para rubber were in good condition, and showed satisfactory preparation, composition and physical properties. Both were in biscuit form and light to dark brown in colour; one from the Issorora Station, contained 93·8 per cent. of caoutchouc, and the other from the Onderneeming Farm, 95·1 per cent. of caoutchouc. A number of paper-making materials from British Guiana were also examined.

Enquiries.—Information was supplied relating to conditions in the balata market.

Exhibits.—The value and appearance of the British Guiana Court has been improved by the addition of the samples received from the Fourth International Rubber and Allied Industries Exhibition, which include timbers, rubber, rice, sugar, rum, cocoa, coffee, and oils. A map and series of photographs illustrating the sugar, balata, and rubber industries of the Colony were lent to the British Guiana Section of that Exhibition.

Falkland Islands.

Investigations.—A sample of water from the hot springs which are situated all round the coast of Deception Island, South Shetlands, resembled in composition the water from the Strong Sulphur Spring at Harrogate.

Three samples of penguin guano from Cochon Island and two from Kidney Island were examined and valued as manures, and recommendations made as to the preparation of the material for the market.

A specimen of whale rib, representative of large quantities of such bones available in the South Shetlands as a by-product of the whaling industry, was examined and valued.

Enquiries.—Information was supplied relating to the production of oil by the distillation of peat.

Exhibits.—Additions to the Falkland Islands Court include a valuable exhibit of whale products, five species of whale being represented. A series of photographs illustrating the whaling industry has also been added.

Australia and Papua.

Investigations.—Three samples of radio-active ores from Mount Painter, South Australia, were found to contain small quantities of the uranium minerals, torbernite and autunite, the richest sample

containing 2·10 per cent. of uranium oxide (U_3O_8). A large number of British and Continental firms interested in the production of radium who were consulted, were of opinion that it would not be feasible to ship ore of this quality to Europe, and that it would have to be concentrated for export.

A number of other minerals from Australia were examined during the year, including osmiridium and kaolin from Tasmania, mica from Queensland, etc.

Three samples of cotton from Western Australia were received, representing the products of plants two years old, grown without irrigation. The sample of Russell cotton was of fairly good strength, but rather shorter and harsher than is usual for cotton of this variety. The Long Staple (Upland) cotton was found to be of satisfactory quality, but slightly stained, and weaker than ordinary American Upland cotton. The third sample, consisting of Sunflower cotton, though slightly deficient in strength, was, on the whole, of better quality than either of the other two. All three samples showed evidence of attack by the pink boll worm (*Gelechia gossypiella*), an insect which has recently caused considerable damage to cotton in Egypt, and advice was given regarding methods of dealing with this pest.

Two samples representing the first Ceara rubber prepared in Papua were examined. In sheet form, the rubber showed satisfactory physical properties, and contained 88·5 per cent. of caoutchouc, expressed on the dry rubber. The scrap sample contained 82·3 per cent. of caoutchouc on the dry rubber.

A sample of the bark of *Daphnandra micrantha*, reputed in Australia to have tonic properties, was investigated, at the suggestion of the Imperial Institute, at Messrs. Burroughs, Wellcome and Co.'s laboratories, Dartford (see F. R. Pyman: Transactions of the Chemical Society, 1914, volume 105, page 1679). It yielded three new alkaloids and the results obtained in their chemical and physiological examination were of considerable interest.

Among other plant products dealt with for Australia during the year were the timber of *Melanorrhoea Maingayi* from Victoria, mallet bark from Western Australia, yacca "gum," fibres for hat-making, etc., and an investigation of *Homeria miniata* was in progress at the close of the year.

Enquiries.—Perhaps the most important Australian enquiry dealt with was that relating to the pearl-shell industry. These shells are largely used for the manufacture of buttons, and though the greater proportion of the Australian output is shipped to London, its ultimate destination has hitherto been largely the factories of Germany and Austria. These outlets being now closed by the War, enquiries were made from a number of commercial experts as to the possibilities of extending the utilisation of these shells in the United Kingdom, and the results were summarised in a memorandum forwarded to the Commonwealth Government. Information was also supplied regarding the marketing in England of zinc, lead, and wolfram ores, hitherto mostly exported to Germany.

Enquiries on a great variety of other subjects concerning the Commonwealth and its resources were also dealt with. Among these were:—Molybdenite, monazite sand, wolfram and bismuth ores, tantalum ore, wattle (mimosa) bark, copra and coconut oil, fibres for various purposes, sugar from the prickly pear, and coconut planting in Norfolk Island.

Exhibits.—The work carried out in the Australian section of the Public Exhibition Galleries during 1914 has been concerned chiefly with the re-arrangement of the present exhibits, and the addition of printed descriptive and other labels and the revision of statistical boards. The exhibits received for the New South Wales Court comprise a valuable collection of gold nuggets, crystallised gold, gems and associated minerals lent by Professor A. Liversidge, F.R.S., samples of wines and hand-specimens of commercial timbers. Exhibits added to the Western Australia Court include leather and leather goods, Jarrah paving blocks, mallet bark and models of fruits. A new show case has been provided for the South Australia Court by the Hampton Cloncurry Mining Company, for the display of specimens of copper ores presented by the Company. Photographs have been added to the Tasmania Court. Sections of gold nuggets, lent by Professor A. Liversidge, F.R.S., have been placed on exhibition in the Papua Court.

The chief need of the Australian section is modernisation. Efforts in this direction would be most effective if carried out as an essential part of a scheme of reorganisation in which a Commonwealth Court, sub-divided according to different classes of products, would replace the present system of separate Courts for the separate States of the Commonwealth. Such an arrangement would more faithfully represent modern conditions, and would in addition bring the present Australian section into line with those of South Africa and Canada, which have already been reorganised on this basis. Such a scheme was approved by the Commonwealth Government, but owing to the war its execution has been deferred.

New Zealand.

Enquiries.—A memorandum was furnished to the High Commissioner on the distillation and marketing of various essential oils. Recommendations were made as to the selection and cultivation of the plants, and information was supplied as to methods of obtaining the oils and machinery for the purpose, and as to methods of packing the products.

Information was also supplied to enquirers on the subject of New Zealand hemp (*Phormium tenax*), infusorial earth, and the possibility of utilising the "Puriri" wood of New Zealand as a source of khaki dye, an exceptional demand for which arose on the outbreak of the war.

Exhibits.—The exhibits received in the New Zealand Court comprise examples of the boxes and crates used in the export of dairy produce, polished specimens of Kauri resin, and specimens of sinter from Rotomahana, and sections of gold nuggets lent by Prof. Liversidge, F.R.S.

Fiji.

Investigations.—A sample of vetiver oil differed considerably in chemical and physical characteristics from one from the same Colony previously examined (*cf.* Annual Report for 1910 [Cd. 5467–23], p. 33), but it still resembled the "heavy" vetiver oils produced in Europe, rather than the "light" oil distilled in Réunion.

The results of a detailed chemical examination of the oil of *Cymbopogon coloratus* have been published in a paper by Dr. E. Goulding and Mr. J. C. Earl of the Scientific and Technical Research Department Staff (Proceedings of the Chemical Society, 1914, Vol. 30, p. 10).

Two samples of jute were examined.

Enquiries.—A memorandum was furnished to the Government on the manufacture of alcohol from bananas and other products, and as to the use of alcohol as a motor fuel. Information was also supplied as to methods for the preparation of jute.

Exhibits.—The exhibits of Fiji products received from the Fourth International Rubber and Allied Industries Exhibition, including rubber, oils and oil-seeds, and timbers, have been placed in the Court; coloured statistical diagrams, illustrating the trade of the Colony, have also been added. A series of Fiji products was prepared for exhibition at the Bristol International Exhibition, 1914.

Western Pacific.

Investigations.—A sample of resin from the tree *Agathis macrophylla* from the Solomon Islands was found to be of considerable commercial and scientific interest and closely resembled "soft Manila copal." The resin could probably be used in the manufacture of spirit varnishes as a substitute for "spirit Manila copal." Recommendations were made as to methods of cleaning and grading the resin, and as to its collection from the trees.

A sample of Manila hemp prepared from plants introduced to the Solomon Islands from the Philippines was of very good quality.

Exhibits.—A new centre case has been installed in the Western Pacific Court, which has also received additional exhibits from Tonga (Friendly Islands). A number of samples of produce of the Solomon Islands were prepared for exhibition at the Bristol International Exhibition, 1914.

United Kingdom.

Investigations.—Investigations were carried out for and information supplied to Government Departments, commercial firms, and private enquirers relating to resources of the British Isles, the undertaking of manufacturing processes, and markets for various products in the United Kingdom, and allied subjects.

A number of products have been examined, and a variety of information has been supplied, on behalf of British Consuls and representatives in foreign countries, and British companies established, or operating, abroad.

Among products of the United Kingdom which were examined during the year was a sample of *Phormium tenax* (New Zealand hemp) grown in Scotland, which was of promising quality.

The specimens accompanying the reports of the mineral surveyors in the Mozambique Company's territory for 1913 were examined and reported on; those accompanying the reports for 1914 were under examination at the end of the year.

Enquiries.—The enquiries dealt with by the Technical Information Bureau related in a large proportion of cases to the manufacture in the United Kingdom of goods hitherto manufactured in Germany, or to the obtaining of materials, the supplies of which were curtailed by the war. Thus, information was supplied to a large number of enquirers on the subject of potash and potash salts, a firm requiring pure materials for silvering mirrors were put into touch with manufacturers in the United Kingdom, a firm of margarine manufacturers were informed where they could obtain milk cultures; information was supplied as to the manufacture of thymol, paraffinum liquidum, salicylates, and a variety of other chemical and pharmaceutical products. A number of enquiries were received relating to glass manufacture and the difficulty of obtaining various glass goods. Other subjects on which information was supplied were the commercial utilisation of sulphur dioxide and the manufacture of sulphuric acid, soy beans, ground nut crushing, and methods of disinfecting cotton-seed.

Comprehensive memoranda were prepared for the Colonial Office on the subject of wild silks of a number of different kinds, and the possibilities of sericiculture in the Colonies and India, as well as on the cultivation of flax for seed in India and the Colonies, and on raw materials available within the Empire for paper making. Information was also supplied to the Colonial Office on esparto grass and on the production of synthetic rubber, to the Board of Agriculture on coconut and palm kernel cakes, to the Board of Trade on palm leaves, and to the Treasury Solicitor on the uses and market value of quebracho wood.

Exhibits.—The United Kingdom is at present represented by the Reference Collection of Economic Products, which is housed in the Upper East Gallery. This is a special representative collection of standard commercial samples, both raw materials and articles in different stages of manufacture being shown. The arrangement of the collection is on lines calculated to render it especially useful to manufacturers and commercial firms interested in Colonial products. Important additions were made to this collection during 1914.

A collection of oils and oil-seeds was lent for purposes of lecture illustration. Samples of rubber were lent to the South African Section of the Fourth International Rubber and Allied Industries Exhibition.

APPENDIX.

PUBLICATIONS ISSUED IN 1914.

The Bulletin of the Imperial Institute is published quarterly by Mr. John Murray, 50a, Albemarle Street, London, price 2*s.* 6*d.* (annual subscription 11*s.* including postage), and may be purchased through any bookseller or from agents in the Colonies and India. The *Bulletin* contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles, chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (animal, vegetable and mineral).

It is satisfactory to record that the circulation of the *Bulletin* is steadily increasing, whilst the extent to which its contents are constantly quoted by newspapers and periodicals is evidence of the estimation in which it is held as the authoritative source of information on the subjects with which it deals.

Other Publications.—During 1914 the following official publications relating to the work of the Imperial Institute were issued :—

Annual Report on the Work of the Imperial Institute, 1913. (Colonial Reports—Annual, No. 816, Cd. 7622–7.)

Report on the Results of the Mineral Survey of Ceylon, by Professor Dunstan. (Colonial Reports—Miscellaneous, No. 87, Cd. 7175.)

Report on the Results of the Mineral Survey of Southern Nigeria, 1913, by Professor Dunstan. (Colonial Reports—Miscellaneous, No. 89, Cd. 7567.)

Selected Reports from the Scientific and Technical Department, Part V., Oil-seeds, Oils, Fats and Waxes. (Colonial Reports—Miscellaneous, No. 88, Cd. 7260.)

The following is a list of scientific and technical books and papers published during the year by members of the Staff of the Imperial Institute :—

Presidential Address, International Congress of Tropical Agriculture, 1914, by Professor W. R. Dunstan, C.M.G., LL.D., F.R.S. (London : John Bale, Sons and Danielsson, Ltd.)

"Rubber : Its Sources, Cultivation and Preparation," by Harold Brown. (Imperial Institute Handbooks on Tropical Resources. London : John Murray.)

"Volatile Oil from the leaves of *Barosma venusta*," by Dr. E. Goulding and O. D. Roberts. (Transactions of the Chemical Society, 1914, Vol. 105, p. 2613.)

"The Volatile Oil of *Cymbopogon coloratus* from Fiji," by Dr. E. Goulding and J. C. Earl. (Proceedings of the Chemical Society, 1914, Vol. 30, p. 10.)

"The Genetic Classification of Rocks and Ore Deposits," by T. Crook. (Mineralogical Magazine, 1914, Vol. 17, No. 79, p. 55.)

"Monazites from Some New Localities," by S. J. Johnstone. (Journal of the Society of Chemical Industry, 1914, Vol. 33, p. 55.)

"The Viscosity of Rubber Solutions," by Dr. R. Gaunt. (Journal of the Society of Chemical Industry, 1914, Vol. 33, p. 446.)

"The Estimation of Hydrocyanic Acid in Feedingstuffs, and its Occurrence in Millet and Guinea Corn," by Dr. J. R. Furlong. (The Analyst, 1914, Vol. 39, p. 430.)

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page:—

ANNUAL.

No.	Colony, &c.	Year.
846	Seychelles	1914
847	St. Helena	,,
848	Fiji	,,
849	Bahamas	1914–1915
850	Gibraltar	1914
851	Sierra Leone	,,
852	Grenada	1914–1915
853	Bermuda	1914
854	Malta	1914–1915
855	Ceylon	1914
856	Hong Kong	,,
857	Bechuanaland Protectorate	1914–1915
858	Basutoland	,,
859	Gold Coast	1914
860	Jamaica	1914–1915
861	Gambia	1914
862	Straits Settlements	,,
863	Northern Territories of the Gold Coast	,,
864	Ashanti	,,
865	Cyprus	1914–1915
866	Swaziland	,,
867	Somaliland	,,
868	British Honduras	1914
869	British Solomon Islands	1914–1915
870	Tongan Islands Protectorate	,,
871	Barbados	1914–1915
872	Falkland Islands	1914
873	Uganda	1914–1915
874	British Guiana	,,
875	Mauritius	1914
876	Leeward Islands	1914–1915
877	Trinidad and Tobago	,,
878	Nigeria	1914
879	Cayman Islands	1914–1915
880	St. Lucia	,,
881	East Africa Protectorate	,,

MISCELLANEOUS.

No.	Colony, &c.	Subject.
79	Northern Nigeria	Mineral Survey, 1907–8 and 1908–9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments, &c.
85	Southern Nigeria	Mineral Survey, 1911.
86	Southern Nigeria	Mineral Survey, 1912.
87	Ceylon	Mineral Survey.
88	Imperial Institute	Oilseeds, Oils, &c.
89	Southern Nigeria	Mineral Survey, 1913.
90	St. Vincent	Roads and Land Settlement.

COLONIAL REPORTS—ANNUAL.

No. 781.

ENTOMOLOGICAL RESEARCH COMMITTEE.

REPORT FOR 1912-13.

Presented to both Houses of Parliament by Command of His Majesty.

January, 1914.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
By DARLING AND SON, LTD., BACON STREET, E.

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T. FISHER UNWIN, LONDON, W.C.

1913.

[Cd. 7050-22.] *Price* 1*d.*

No. 781.

ENTOMOLOGICAL RESEARCH COMMITTEE.

REPORT ON THE WORK OF THE COMMITTEE SINCE 8TH OCTOBER, 1912.

I.

THE EARL OF CROMER TO MR. HARCOURT.

London,
17th December, 1913.

SIR,

IN my Report of the 8th of October, 1912,* account was given of the work which had been accomplished by the Entomological Research Committee, of which I have the honour to be Chairman, during the three years of its existence; but although little more than a year has elapsed since that date the work of the Committee has developed, and is developing, so rapidly that it becomes necessary to submit a further Report now and it is proposed in future to make a Report every year.

Since the establishment of the Bureau we have discontinued the use of the title "Entomological Research Committee," as confusion seemed likely to arise from the existence of what were apparently two separate organisations in London working at the same subject. The Entomological Research Committee has, therefore, now become the Managing Committee of the Bureau, and Mr. Guy Marshall, who held the appointment of Scientific Secretary to the Entomological Research Committee, has been made Director of the Bureau.

2. The chief feature of the work of the past year has been the actual establishment of the Imperial Bureau of Entomology to which reference is made in the 14th and 15th paragraphs of my previous Report. The following contributions are being made annually by the Governments concerned:—

	£
Great Britain	500
Canada	500
India	500
Australian Commonwealth	200
Six Australian States	300
South Africa	350
New Zealand	200
Newfoundland	50
Ceylon	100
Malay States	100
Straits Settlements	50
Hong Kong	50
Mauritius	50
Seychelles	25
West Indies	250
Egypt	50
Soudan	50
Fiji	50
	£3,375

* No. 1 in [Cd. 6429], November, 1912.

As the Imperial Government already contributes on behalf of the State-aided Protectorates in Tropical Africa an annual sum of £1,000 a year for the general work of the Committee, the West African Colonies a sum of £1,000 a year, and Zanzibar a sum of £50 a year, the whole organization is singularly comprehensive and, from the information which has reached me, is proving of great utility not only to countries within the Empire but also to those without.

3. The Review entitled the "Review of Applied Entomology," which is issued by the Bureau every month, is making satisfactory progress and the material available for publication is steadily increasing, more especially on the agricultural side. The total number of periodicals examined for the purposes of the Review is 895, and approximately 4,500 separate parts have been searched for useful entomological information between January and November of this year. The number of articles abstracted or reviewed during eleven months is 860, published in the following countries:—

United States	193	Holland and Belgium ...	24
France	135	West Indies	23
Great Britain	128	Central and South America	23
Germany	45	French Africa	12
Italy	43	Switzerland	11
Canada	42	Spain	10
British Africa	39	German East Africa ...	5
East Indies	35	Austria	4
Russia	31	Egypt	2
India and Ceylon	28	Cyprus	1
Australasia	25	Denmark	1

4. Arrangements have been made for the representation of the self-governing Dominions and India on the Committee of Management of the Bureau by the following members of the Committee:—

Australia	Mr. F. V. Theobald
Canada	Dr. A. E. Shipley
India	Professor Maxwell Lefroy
New Zealand	Mr. E. E. Austen
South Africa	Mr. G. A. K. Marshall

Special arrangements have been made to meet the wishes of the Australian State Governments to be represented by one of the Agents-General, and we are fortunate in having obtained the services of the Hon. Sir John McCall, Agent-General of Tasmania, in this capacity.

5. The Bureau has made considerable progress towards obtaining a complete set of the various laws and regulations against injurious insects which have been promulgated in the British Dominions and Colonies, and arrangements are now being made to collate and summarise them in a convenient form.

6. The Bureau has also extended the sphere of its activities in another important direction. Major S. P. James, of the Indian Medical Service, was recently deputed by the Indian Government to visit South and Central America and report on the possibility

(33032—6.) Wt. 35104—688. 1125 & 90. 1/14. D & S.

of yellow fever being introduced into India by the increased traffic across the Pacific Ocean which will inevitably follow the opening of the Panama Canal. It appeared from his report that there is little or no knowledge, not only of a sure method of diagnosing the disease, but also of the presence or absence—and of the distribution if present—in Eastern lands of the mosquito which is known to convey the disease (*Stegomyia fasciata*).

7. It also appeared that there is a similar want of knowledge as to whether *Stegomyia scutellaris*, another very widely distributed and abundant species of mosquito of the same genus, carries the disease or not, and as to many other matters of capital importance affecting the etiology and prevention of yellow fever. Should it be necessary, therefore, to deal with an outbreak of yellow fever in a new territory, it is evident that this want of knowledge would greatly hamper and delay efficient and enlightened administrative action.

8. The co-operation of the Bureau of Entomology was invited on behalf of India and the Eastern Colonies, and the Bureau has undertaken to collect information as to the distribution of the *Stegomyia* mosquito in the countries which are likely to provide ports of call for vessels coming from infected districts.

9. As a preliminary measure the Bureau has asked to be furnished with all information available as to the distribution of mosquitoes generally, and of the genus *Stegomyia* in particular, in the French, German, Japanese, American, and Dutch possessions in the Far East and the Pacific, and to be provided with collections of mosquitoes from these localities. The question of sending out an entomologist specially to collect information in those places from which none can now be obtained may be considered at a later date in the light of the knowledge thu· gained.

Dr. A. T. Stanton has kindly offered to supply the Committee with collections and data from the Federated Malay States and has written to various correspondents in the East asking them to do the same. He is shortly visiting Siam and Indo-China, and will utilise the opportunity to further our enquiry. Mr. J. C. Moulton, of the Sarawak Museum, has agreed to assist us in Borneo, and Mr. P. D. Montague, of Cambridge, who has just started on a zoological expedition to New Caledonia, has kindly consented to collect mosquitoes for us both there and in any ports visited *en route*. In Hong Kong the medical authorities have already made a preliminary mosquito survey.

With regard to the littoral of South East Africa, concerning the mosquito fauna of which we have but little knowledge, Mr. C. P. Lounsbury, Chief Entomologist of the Union, has been good enough to suggest the names of persons who might help us, and letters have been written to them. He has also asked the authorities in Delagoa Bay to communicate with the Committee, and has promised further information after the completion of his present tour of the South African ports.

10. In this connexion it may be mentioned that the West African Yellow Fever Commission recently applied to the Bureau for information with regard to the distribution of mosquitoes in British West Africa and that the Bureau was able to supply

a very useful statement setting forth the locality-records for all known species. A considerable amount of additional material has since been received and a supplementary statement has now been furnished.

11. The Committee are also taking steps to render assistance in another important direction. Arrangements have been made with Mr. W. F. Fiske, one of the most capable entomologists lately in the service of the United States Bureau of Entomology, to carry out, under the direction of the Royal Society and at the expense of the Government of Nyasaland, a thorough investigation of the bionomics of the tsetse fly *Glossina morsitans*. In the first instance, however, he is investigating the allied species *Glossina palpalis* in Uganda, as a preliminary to his work on *Glossina morsitans*, which will be carried out in Nyasaland. The Committee, with Mr. Carnegie's consent, are placing at his disposal the services of one of the Carnegie Scholars who, as you are aware from my previous Report, are being trained in American methods of entomology with the help of funds which Mr. Carnegie has generously provided for the purpose.

12. It is to be hoped that this will be the beginning of an organised campaign against the various species of tsetse fly throughout Africa, and the Committee are now considering whether they cannot render further assistance by employing the two entomologists who are working under their direction in East and West Africa respectively entirely on investigations connected with tsetse flies. It is clear that the discovery of any effective method of dealing with these flies in Africa would have the most far-reaching effects on the prosperity and progress of that continent.

13. To turn to the more routine side of the work of the Committee, some 80,000 specimens have been received since the date of my last Report, of which 14,000 are blood-sucking insects. Nearly all the latter have been identified, as well as numerous insects of agricultural importance. In the course of the year 248 lists of names have been sent out to 107 different correspondents, involving about 3,500 specific identifications. In addition to numerous sets of named insects returned to correspondents, large collections of African ticks, named at Cambridge by Professor Nuttall and Mr. Warburton, two members of the Committee, and of blood-sucking flies have been issued to the following institutions:—British Museum, the Universities of Oxford, Cambridge, Edinburgh, Aberdeen, and Manchester, the London and Liverpool Schools of Tropical Medicine, the Royal Veterinary College (Camden Town), the Imperial College of Science and Technology, the Museums at Birmingham, Leicester and Warrington, and the King Institute of Preventive Medicine, Madras; while over 74,000 insects which are not of economic importance have been handed over to the British Museum.

14. The Bureau has continued to publish its quarterly journal, the "Bulletin of Entomological Research," which contains only original articles. This excellently illustrated publication has maintained its previous high standard, and mention may be

made of some of the more important articles that have appeared in it during the past twelve months. Messrs E. E. Austen and F. W. Edwards, of the British Museum, have communicated several papers on blood-sucking horse-flies and mosquitoes from Africa; and Mr. S. A. Neave, Travelling Entomologist to the Bureau, has given an account of all the blood-sucking flies known to occur in our Protectorates in Eastern Africa. Dr. J. W. Scott Macfie has published a very valuable and comprehensive survey of the tsetse flies of the Ilorin Province, Northern Nigeria; while useful observations on the bionomics of these dangerous insects have been furnished by several other authors. The breeding habits of the malaria-carrying mosquitoes of St. Lucia have been fully dealt with by Dr. Lucius Nicholls; while Dr. Johann Dewitz, of Geisenheim, and Dr. Trägårdh, of Stockholm, have shown the importance of studying the physiology of injurious insects as an aid to their destruction.

15. The question of the identification of parasitic *Hymenoptera* is becoming a pressing one, owing to their great importance in the control of injurious insects. Unfortunately the number of reliable specialists working at these groups is extremely limited, and they already have more work than they can do. The Committee therefore propose that one or more of the assistants working under the Director of the Bureau should devote themselves to this group of insects. For the identification of the African *Tachinidæ* (a very useful family of parasitic flies) the Committee has been fortunate in securing the generous assistance of Dr. Villeneuve, of Rambouillet, who has kindly agreed to name all the material submitted to him.

16. All this extension of the work of the Committee has entailed a considerable extension of the staff. It has been found necessary to accommodate the Bureau for the time being in a suite of rooms in Elvaston Place, while the Trustees of the British Museum have continued to extend their generous assistance to the Committee by providing accommodation for the Director and his increasing staff of personal assistants at the British Museum (Natural History).

At present some 75 per cent. of the material received by the Bureau comes from tropical Africa, as it is there that the Committee has been longest at work, and there its organisation has been most fully perfected. As, however, the many other countries which have now come within the scope of the Committee's activities avail themselves of its services I anticipate that greater extension both of staff and of accommodation will be required, and I am anxious that the work of the Committee should suffer no set-back by any inadequate provision under these two heads.

17. Mr. Andrew Carnegie has, with great generosity and public spirit, renewed for a further period of three years his grant of £1,000 a year for the purpose of giving some young men selected in this country a thorough training in the methods employed in the United States in dealing with noxious insects. That the purpose of the grant is being attained is shown by the fact that the two previous Carnegie Scholars, Mr. A. Rutherford

and Mr. Strickland, received immediate employment on the termination of their entomological work in America. Mr. Rutherford was appointed Entomologist for Ceylon in succession to Mr. Green, and sailed at the beginning of last March to take up the duties. Mr. Strickland has been appointed Medical Entomologist in the Federated Malay States. In view of the growing demand for competent Entomologists both by Government administrations and private enterprises the establishment of a body of well-trained entomologists of this kind is a matter of great practical importance. I am glad to have this opportunity of referring to the valuable assistance which the Committee has always received from the State Department of Entomology at Washington, and I cannot refrain from quoting the following extract from a letter received by the Director of our Bureau from Dr. O. Howard, the distinguished Head of the Department:—

"Mr. Fiske was here recently, enthusiastic over the prospect of doing some work for your country. I think he has a great opportunity. Incidentally, in conversation, he said that he had the impression that you were loath to ask favors of me, feeling that you did not wish to intrude on my time. I beg to assure you, however, that I will do gladly anything I can for you or for the men you send over. I have a distinct feeling of pleasure in the thought that I am able to be of service to you and your people. It is really a compliment that you pay me in asking me to do this for you, and I trust that you will not hesitate for a moment to give me any chance to help you."

The grateful thanks of the Committee are also due to the authorities of Harvard and Cornell Universities, who have been good enough to remit all fees in connexion with the classes of instruction attended by our Carnegie scholars.

18. It is difficult to give an adequate account of the manifold activities of the Committee within the compass of an official report, but reference may be made to two or three representative instances.

19. You are aware of the assistance which the Committee has rendered to the sugar planters of Trinidad in dealing with the frog-hopper pest, and I am glad to be able to record another case in which the Committee has been able to give practical help to the sugar industry. As the result of his visit to the West Indies the Director, Mr. Guy Marshall, was able to show that the beetle, *Phytalus*, which was devastating the sugar-cane in Mauritius, was indigenous in Barbados, and in a larva which he brought home a parasite was found. The Superintendent of Agriculture in Barbados was advised to investigate the life-history of this parasite and he soon showed that it was effectively controlling the beetle. Consignments of the parasite have now been sent to Mauritius and there is every hope that the species may be successfully established in that island.

20. As an instance of assistance in another direction, I am informed that it is often a matter of difficulty for entomologists in the Colonies and elsewhere to secure really good reproductions of insects for their publications. The Bureau has accordingly

made arrangements for meeting this difficulty and has supervised, on behalf of the Egyptian Department of Agriculture, the drawing and reproduction of several coloured plates; it has also prepared numerous blocks for the Government Entomologist of Trinidad. The Imperial Commissioner of Agriculture for the West Indies has asked to be permitted to avail himself of the opportunities thus offered, and Sir Charles Lukis has sought advice with regard to the entomological illustrations for the new publication of the Indian Research Fund Association

21. It would be easy to multiply instances, but enough has already been said to show both the range and variety of the Committee's activities and the great amount of useful public work it is accomplishing. The problems which it is engaged in solving are so important and so numerous that it seems difficult to assign any limits to the possibilities of its beneficent action in the future, and I cannot too strongly urge that every effort should be made to provide, either from public funds or by appeal to private generosity, the money which will be required to place it in a position to carry out its work adequately and with efficiency.

22. Finally, I am glad to have again an opportunity of referring to the valuable services which the expert members of the Committee have rendered with so much zeal and public spirit. There is such an obvious desire to further in every way the work of the Committee that, although I am unable to lay any claim to technical knowledge upon the various scientific questions discussed, my office of chairman is none the less extremely interesting, and is also a source of real pleasure to myself.

23. The development of the Bureau has thrown upon the two Secretaries, Mr. Guy Marshall and Mr. Parkinson, a large increase of work which they have readily undertaken and carried out to the entire satisfaction of the Committee.

I have the honour to be,
Sir,
Your most obedient servant,
CROMER.

The Rt. Honble. L. Harcourt, M.P.,
&c., &c., &c.

II.

COLONIAL OFFICE TO THE EARL OF CROMER.

Downing Street,
27th December, 1913.

My Lord,

I am directed by Mr. Secretary Harcourt to acknowledge the receipt of the further Report on the work of the Entomological Research Committee with which you have been good enough to furnish him. The Report clearly indicates the value

of the work of the Committee and the rapidity with which it is expanding, and he gladly concurs in your proposal that such Reports should in future be annual.

2. Mr. Harcourt is of opinion that it is a matter for hearty congratulation that you should have succeeded in establishing the Imperial Bureau of Entomology on so wide a basis and that such good progress should already have been made in its development. He is confident that you have not in any way overrated the importance of the part which the Bureau must play in the economic development of the oversea possessions of this country, and he trusts that its utility will receive practical recognition in the supply of such funds as are needed to give full scope to its activities.

3. He has read with much interest the account of the entomological investigations which have been set on foot in view of the possibility of yellow fever being introduced into India and the Eastern Colonies by the increased traffic across the Pacific Ocean which must follow the opening of the Panama Canal, and he has no doubt that the Bureau will render a great service to the Administrations of those countries by supplying them with accurate information on which to base their protective measures. It appears from correspondence which the Foreign Office has communicated to this Department that the Governments of France, Japan, and Holland have already taken steps to co-operate with the Bureau in this work; and replies will no doubt be shortly received from the other Governments referred to in the 9th paragraph of your Report.

4. Mr. Harcourt has noted with pleasure that the Bureau has been able to assist the important Commission which is investigating the question of yellow fever in the British possessions in West Africa.

5. With regard to the 11th and 12th paragraphs of your Report, I am to say that he entirely concurs in your view that the discovery of any effective method of dealing with the tsetse fly in Africa would have the most far-reaching effects on the prosperity and progress of that continent. In spite of the havoc wrought by this fly, singularly little seems to be known regarding its life-history, and he trusts that, as you suggest, the present inquiry will lead to a comprehensive investigation of the whole question and to concerted action throughout Africa.

6. He understands that the control of noxious insects by other insects which are natural enemies and of a harmless type is a branch of entomological work which has been successfully developed in the United States, and he has been glad to observe from the 14th paragraph of your Report that this important matter is receiving the consideration of the Committee.

7. He has readily given his approval to the increases of staff which you have recently recommended, and he desires to take this opportunity of expressing his grateful thanks to the Trustees of the British Museum for the assistance which they have so generously afforded the Committee by continuing to provide accommodation for the Director of the Bureau and his personal assistants.

8. He recognises that Mr. Andrew Carnegie has rendered a public service by renewing his grant of £1,000 a year for a further period of three years, and he thinks that it must be a source of gratification to him that the organization which he is so generously supporting is rapidly developing and is rendering valuable assistance in the campaign against those insect pests which are responsible for a heavy mortality in human beings and animals and are the cause of serious injury to the crops on which man is dependent for his food or his industries.

9. He has noted with special pleasure your reference to the sympathetic and generous attitude of the American State Department of Entomology and the Universities of Harvard and Cornell towards the Bureau.

10. From information which has reached him he gathers that the work in connection with the frog-hopper pest in Trinidad is proceeding satisfactorily, and he considers that the sugar planters of the island are much indebted to the Committee for the valuable advice which they have given in the matter. He will await with much interest the result of the measures which are being taken in Mauritius to eradicate the beetle which is injuriously affecting the sugar plantations of the island.

11. He desires to associate himself with the well-deserved tribute which you have paid to the expert members of the Committee who, by their generous co-operation, have rendered such valuable services since the scheme was first inaugurated, and he has noted with pleasure the appreciative terms in which you refer to the two secretaries, Mr. Guy Marshall and Mr. Parkinson.

12. In conclusion, Mr. Harcourt asks me to express his grateful thanks to you for the skill with which, from comparatively small beginnings, you have developed this organization into its present satisfactory condition. He feels assured that, under your tactful and energetic direction, the work of the Committee will continue to expand on sound lines and will prove of the utmost value to the British possessions in all parts of the world.

I have, &c.,

JOHN ANDERSON.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page :—

ANNUAL.

No.	Colony, &c.	Year.
752	St. Lucia	1911–1912
753	Gilbert and Ellice Islands	1911
754	Cayman Islands (Jamaica)	1911–1912
755	Gibraltar	1912
756	St. Helena	"
757	Weihaiwei	"
758	Ceylon	1911–1912
759	Sierra Leone	1912
760	Seychelles	"
761	Somaliland	1912–1913
762	Hong Kong	1912
763	Turks and Caicos Islands	"
764	Falkland Islands	"
765	Northern Territories of the Gold Coast	"
766	Bahamas	"
767	Gambia	"
768	Fiji	"
769	Basutoland	1912–1913
770	Gold Coast	1912
771	Ashanti	"
772	Nyasaland	1912–1913
773	Bechuanaland Protectorate	"
774	British Solomon Islands	"
775	Colonial Survey Committee	"
776	Tonga Island Protectorate	1911–1913
777	Swaziland	1912–1913
778	Imperial Institute	1912
779	Barbados	1912–1913
780	British Guiana	"

MISCELLANEOUS.

No.	Colony, &c.	Subject.
77	St. Vincent	Roads and Land Settlement Fund.
78	Weihaiwei	Census, 1911.
79	Northern Nigeria	Mineral Survey, 1907–8 and 1908–9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments.
85	Southern Nigeria	Mineral Survey, 1911.
86	Southern Nigeria	Mineral Survey, 1912.

COLONIAL REPORTS—ANNUAL.

No. 834.

IMPERIAL BUREAU OF ENTOMOLOGY.

REPORT FOR 1914.

(For Report for 1912-13 see No. 781.)

Presented to both Houses of Parliament by Command of His Majesty.
February, 1915.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
By BARCLAY AND FRY, LTD., THE GROVE, SOUTHWARK STREET, S.E.

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1915.

[Cd. 7622–25]. *Price* 1*d*.

No. 834.

IMPERIAL BUREAU OF ENTOMOLOGY.

REPORT FOR 1914.

Mr. AUSTEN CHAMBERLAIN to the SECRETARY OF STATE.

London, 16th February, 1915.

SIR,

In December, 1913, the Earl of Cromer submitted a report (Colonial Report Annual, No. 781), on the work accomplished by the Imperial Bureau of Entomology during the year, and stated that he proposed in future to make a report every year.

2. Unfortunately Lord Cromer has had to resign the Chairmanship of the Managing Committee of the Bureau owing to ill-health, and you have done me the honour to ask me to succeed him as Chairman, a request to which I readily agreed. Although I have only just accepted your offer, it is clear from the papers which I have had before me and from what I have been able to learn by personal enquiry, that the Bureau is doing excellent work, and I have much pleasure in being able to submit so satisfactory an account of its operations during the year 1914.

3. Before proceeding to the report itself, I must express on behalf of all the Committee the deep regret with which they have learnt of Lord Cromer's resignation and the reasons which have led him to take that step. I am assured that he was an ideal Chairman, and that his wise judgment has been invaluable in guiding the decisions of the Committee ever since it was instituted by your predecessor, the Marquess of Crewe, as the "Entomological Research Committee" in June, 1909.

4. The Bureau has now been established for two years, and I am glad to be able to record the emphatic opinion of the Committee that it has more than justified its existence. From many quarters the Director has received appreciation of its work, and there is no reason to doubt that if the necessary funds for its maintenance are obtained, it will continue to be of real assistance not only to the Dominion and Colonial Governments, but also to foreign Governments which are closely interested in entomological problems. It appears, moreover, that commercial firms who are engaged in enterprises in the Colonies are realising the value of having practical entomologists on their staffs, and it is satisfactory to note that the senior assistant

(C119) Wt.36076/850. 1125 & 90. 2.15. B.&F.,Ltd. Gp.13/2.

entomologist at the Bureau has been selected for a post in Fiji with the Colonial Sugar Refining Company of Sydney. If, as a result of the work of the Bureau, the importance of economic entomology is more widely understood, this would alone be ample justification for the expenditure of money which the creation and maintenance of the Bureau has involved.

5. The publications of the Bureau have been continued as in previous years. Every month the "Review of Applied Entomology" is published in two parts, one dealing with Agricultural Entomology, and the other with Medical and Veterinary Entomology. In this Review summaries are given of current literature on all aspects of economic entomology. The work in this connexion has grown considerably, and although the scope of the Review is comprehensive, even now it cannot be called complete, for untapped sources of information are still being discovered. Volume I (1913) contained 788 pages, or an average of 65 pages a month; while Volume II just completed (1914) contains 926 pages, or an average of 77 pages a month, and but for the war, which has prevented German, Austrian and Belgian publications from being received by the Bureau, this volume would probably have reached 1,000 pages. An idea of the general extent of the work can be gathered from the following table, which shows the number of abstracts published:—

RECORD OF ABSTRACTS PUBLISHED IN 1913 AND 1914.

Country of Publication.	No. of Abstracts. 1914.	1913.
United States	315	231
France	202	147
Russia	192	72
Great Britain	160	144
Germany	117	65
British Africa (including Egypt) ..	97	48
India and Ceylon	65	43
Italy	58	43
Central and South America ..	51	25
West Indies	43	23
Australasia	43	39
Canada	41	41
East Indies	29	39
Belgium and Holland	19	25
French Africa	17	12
Austria-Hungary	11	9
German East Africa	11	6
Switzerland	10	12
Scandinavia	5	1
Portugal and Colonies	4	0
Spain	3	10
Hong Kong	1	2
Totals ..	1,494	1,037

It should be added that the total number of periodicals examined for the purposes of the Review is now 1,001, and approximately 4,600 separate parts have been searched for entomological information. Of these periodicals 400 additional parts failed to reach this country on account of the war. A very full index has been compiled to Volume I (1913), and this in itself has involved a great amount of labour.

6. The other regular publication of the Bureau is the "Bulletin of Entomological Research." This is issued quarterly and contains original illustrated articles. Among the most important published during the year may be mentioned contributions dealing with the bionomics of tsetse-flies by Messrs. R. W. Jack, Ll. Lloyd, R. B. Woosnam and Dr. J. O. Shircore; Dr. R. Roper's paper on the malaria-carrying mosquitos of British North Borneo; an account of the blood-sucking insects observed by Dr. J. J. Simpson in the Gold Coast; papers on the agricultural insect pests of Southern Nigeria, by Dr. W. A. S. Lamborn, and of Nyasaland, by Mr. E. Ballard.

An index to the Volume of the Bulletin for 1913 was also compiled and published during the year.

7. In connexion with these publications I cannot refrain from quoting from two among many of the appreciative references made to them by experts who are in the best position, perhaps, to form a sound judgment. Professor Kulagin, the distinguished Director of the Moscow Agricultural Institute, writing to the Director of the Bureau on the subject of the "Review of Applied Entomology," said: "I am prepared to serve you as far as I possibly can. Your journal is necessary for all entomologists, and it is the duty of us all to help you." And Mr. E. Porter Felt, the State Entomologist for New York, recently wrote: "I wish to voice my personal appreciation of the Review published and to express the hope that it will be continued along substantially the same lines, since with the passage of years it is going to be an exceedingly convenient medium for keeping track of work in all branches of entomology." Unsolicited testimony of this kind is perhaps the most gratifying recognition which could be extended to the Bureau.

8. As may be well imagined, the constant examination of periodicals in all languages for entomological information of importance, has enabled the Bureau to build up a useful reference library. Roughly 320 publications, amounting to about 1,500 separate parts annually are received, and I should like to refer especially to the kindness of Dr. C. Gordon Hewitt, Dominion Entomologist to the Canadian Government, in obtaining all the available back numbers of official entomological publications in Canada. Many, too, of the experiment stations in the United States have been very generous in this respect, and deserve our thanks for supplying back numbers of their publications; while Dr. David Sharp, F.R.S., has very kindly presented some 60 volumes of various useful journals. There are now over 400 bound volumes in the library; and in addition to these, a number of separate pamphlets, bulletins, reprints, and duplicates are being accumulated.

9. In the original proposals for the work to be carried out by the Bureau the preparation of a list of the plant pests occurring in each British Colony was suggested. It was contemplated that the list would be drawn up by the Government Entomologist in the Colony, but it is clear that this plan is not feasible, and it has been decided to adopt an alternative arrangement whereby the lists will be prepared in the Bureau from the published literature. The lists will contain information as to the scientific name of the insect; its popular name (if any); an indication of its distribution in the Colony (general, local, hill species, etc.); plants attacked; and the relative importance of the pest. It is proposed to submit the lists to the local entomologists for additions and corrections. This work has already been put in hand, but it will be some time before it can be completed.

10. Reference was made in last year's report to the proposal to collate and summarise the various laws and regulations which have been promulgated in the British Dominions and Colonies for the control of plant pests and diseases. Professor Maxwell Lefroy, a member of the Committee, has kindly undertaken this work, and the summary will shortly be in the hands of the printers. The general scheme adopted is to give a brief summary in non-technical language of the various regulations in force in each country. From these all the essential points have been extracted and arranged so as to form a useful guide for future legislation on the part of those Governments which have not yet dealt comprehensively with the subject. It is believed that it will also prove valuable to those Governments which have already made laws, by indicating where additions or amendments to those laws might be desirable.

11. I will now turn to another side of the work. Two Travelling Entomologists have been employed in Africa as hitherto, although a period of some six months elapsed between the departure of Mr. S. A. Neave from Nyasaland to take up his duties as Assistant Director of the Bureau and the appointment of Dr. W. A. S. Lamborn to succeed him as Travelling Entomologist in East Africa. Mr. Neave had been stationed at Mlanje for the purpose of studying the life-histories of the blood-sucking flies of the family Tabanidæ, many of which undoubtedly play an important rôle in the dissemination of various diseases of domestic animals; and to enable him to carry out his researches, a laboratory was built for him by the Government of Nyasaland at his headquarters. He has succeeded in discovering the breeding habits of no less than twenty different species concerning which nothing was known previously. It was at first intended that Dr. Lamborn should proceed to the East Africa and Uganda Protectorates, but on reconsideration the Committee felt that his services would be more valuable for the time being in Nyasaland. Accordingly, he is now working in that Protectorate, his general objects being to test, by experiment on a fairly large scale, the practicability of eradicating *Glossina* within a given area by direct attack upon the flies themselves, and concurrently with this experiment to test the actual effects on the fly of clearing undergrowth, in order to ascertain whether the clearing really kills the flies or merely drives them elsewhere. It is anticipated that this experiment in destruction of *Glossina* must extend over at least one year, if definite

information is to be obtained as to the likelihood of catching and trapping operations proving really effective in controlling the numbers of the fly.

12. On the West Coast Dr. J. J. Simpson has been employed on special investigations connected with the *Glossina* problem in the Northern Territories of the Gold Coast. A full account of his previous work in the Gold Coast has appeared in Volume V. of the Bulletin of Entomological Research, and it was hoped that he would have been able to collect some equally useful information in the Northern Territories, but I regret to report that when he had only half completed his tour he was invalided home, and he is now recuperating in this country.

13. Arrangements have also been made for Mr. W. F. Fiske, who had spent a year in Uganda working for the Royal Society, to carry out investigations for the Bureau in that Protectorate. He will send in a final report to the Royal Society, and thereafter report to the Director of the Bureau. At present he is living on the Sesse Islands in Victoria Nyanza. He is very hopeful of obtaining successful results to the series of preliminary enquiries which he has been conducting, and the Committee trust that valuable information will be gained by him.

14. The importance of the *Glossina* investigations cannot easily be overrated, as, indeed, appears in the Report of the Sleeping Sickness Committee which you appointed to examine the question of the relation between trypanosomiasis and wild animals. In their general conclusions that Committee reported as follows :—

> "It must be recognised that the evidence all points to the conclusion that if tsetse-fly could be eliminated or removed from contact with human settlement sleeping sickness would practically disappear, infection conveyed by other biting flies being a negligible factor in the spread of the disease.
>
> "For this reason your Committee attach great importance to a proper and sufficient equipment of entomological research into the bionomics of the incriminated tsetse-flies. This form of research has, in their view, been insufficiently pursued up to the present time. The workers have been zealous, but few in numbers, and the work consequently limited to only a very small portion of the fly belts and areas from which the danger arises.
>
> "Different views are taken as to the prospect of dealing with the fly, but it was, as your Committee think truly, said by more than one of the witnesses, that in this form of research there is a large element of chance that accident may at any time lay bare a secret which may lead to the solution of the problem, and that the multiplication of workers is the multiplication of those chances.
>
> "Your Committee think, therefore, that, within reason, there should be devoted to this form of inquiry a considerable portion of such funds as may be available in British possessions, and that endeavours should be made to obtain the co-operation in this work of foreign Powers in their African possessions, the results of the work being from time to time tabulated and collected."

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S
STATIONERY OFFICE
By DARLING AND SON, LTD., Bacon Street, E

1913.

COLONIAL REPORTS, &c.

The following recent reports, &c., relating to His Majesty's Colonial Possessions have been issued, and may be obtained from the sources indicated on the title page:—

ANNUAL.

No.	Colony, &c.	Year.
805	Gambia	1913
806	Gold Coast	"
807	Northern Territories of the Gold Coast ..	"
808	Sierra Leone	"
809	Bahamas	1913–1914
810	Cayman Islands (Jamaica)	1913–1913
811	Fiji	1913
812	Ashanti	"
813	Basutoland	1913–1914
814	Hong Kong	1913
815	Bechuanaland Protectorate	1913–1914
816	Imperial Institute	1913
817	Falkland Islands	"
818	Malta	1913–1914
819	Trinidad and Tobago	"
820	Jamaica	"
821	Northern Nigeria	1913
822	Grenada	"
823	Zanzibar	"
824	Barbados	1913–1914
825	Southern Nigeria	1913
826	Mauritius	"
827	British Honduras	"
828	Colonial Survey Committee	1913–1914
829	Tonga Protectorate	"
830	Swaziland	"
831	Uganda	"
832	Nyasaland	"
833	British Guiana	"

MISCELLANEOUS.

No.	Colony, &c.	Subject.
78	Weihaiwei	Census, 1911.
79	Northern Nigeria	Mineral Survey, 1907–8 and 1908–9.
80	Nyasaland	Mineral Survey, 1908–9.
81	Southern Nigeria	Mineral Survey, 1908–9.
82	Imperial Institute	Rubber and Gutta-percha.
83	Southern Nigeria	Mineral Survey, 1910.
84	West Indies	Preservation of Ancient Monuments, &c.
85	Southern Nigeria	Mineral Survey, 1911.
86	Southern Nigeria	Mineral Survey, 1912.
87	Ceylon	Mineral Survey
88	Imperial Institute	Oilseeds, Oils, &c.
89	Southern Nigeria	Mineral Survey, 1913.

22. It will be necessary to take up in the course of the current year the question of the renewal of these grants, or at any rate of most of the contributions other than those from the African possessions, as in the majority of cases the contributions were guaranteed in the first instance for three years only and this period will have expired at the end of 1915. It would have been convenient to discuss this at the Conference in July, if it could have been held; but, as this is impossible, the matter will have to be dealt with mainly by correspondence.

It is obviously desirable that the Bureau should be placed on a permanent basis as soon as possible, and there would appear to be no doubt that the value of its services has been so generally recognised that, if the contributing Governments were now asked to guarantee contributions, they would be willing to agree. But in present circumstances it seems to be preferable to ask for a renewal of the grants for a limited period only, and at the end of the war to take up the question of obtaining permanent provision for the upkeep of the Bureau.

I may further observe that if the Bureau is to develop as it should, it will be necessary to provide additional staff, and this cannot be done without extra funds. It ought to be possible, for instance, whenever some special piece of entomological research is required in any part of the world, for the Bureau to be able to send one of its own experts to conduct that research; but with its present resources this is quite out of the question. Nevertheless, the Committee feel that it would probably be unwise to seek for increased contributions at so inauspicious a moment, and this question, as well as that of permanency, must therefore stand over for future consideration.

23. I cannot conclude this report without expressing the Committee's appreciation of the work of the Director of the Bureau, Mr. G. A. K. Marshall, the Assistant Director, Mr. S. A. Neave, the Assistant Editor, Mr. W. North, and the whole staff generally. The Committee also desire to express their appreciation of the value of the services of their Secretary, Mr. A. C. C. Parkinson.

We are particularly fortunate in having obtained the services of Mr. Marshall as Director. He has worked with untiring zeal to bring the Bureau to its present state of efficiency; and he has spared himself no trouble in carrying out the multifarious duties which have fallen upon him. The combination of real enthusiasm for the work with expert knowledge and ability render him especially suitable for this appointment, and the Committee gladly recognise how greatly the success of the Bureau is due to him.

I have the honour to be,

SIR,

Your most obedient servant,

AUSTEN CHAMBERLAIN.

The Right Hon. Lewis Harcourt, P.C., M.P.

discussion were "The regulation of plant imports; the inspection of imports and Imperial co-operation in restrictive legislation; and the desirability of establishing an Empire Convention in preparation for the next International Phytopathological Conference."

It is very regrettable that, owing to the war, the Conference has had to be postponed indefinitely; but the Committee trust that when circumstances admit, you will again approach the Governments concerned, and that they will then readily agree to send their entomologists to London.

21. The expenditure of the Bureau is carefully watched, so as to ensure a reasonable balance being kept in hand; but, needless to say, if the funds at our disposal were doubled or quadrupled, we could employ them profitably in extension of the work, parts of which, indeed, are at present retarded, in some cases very seriously, by lack of staff. The annual contributions made to the Bureau are as follows:—

	£
Imperial Government	1,500
Canada	500
Australian Commonwealth ..	200
Six Australian States	300
South Africa	350
New Zealand	200
Newfoundland	50
India	500
Egypt	50
Sudan	50
Nigeria	500
Gold Coast	350
Sierra Leone	100
Gambia	50
Zanzibar	100
Ceylon	100
Malay States	100
Straits Settlements	50
Hong Kong	50
Mauritius	50
Seychelles	25
Fiji	50
West Indies	250
Malta	20
Cyprus	100
Total	£5,595

In addition there is Mr. Andrew Carnegie's donation of £1,000, which has been promised for six years (from 1911 to 1916 inclusive), to provide the studentships referred to above.

It should be explained that the contribution from the Imperial Government includes a grant of £1,000 which was originally approved for the Entomological Research Committee in 1909 on behalf of the Exchequer-aided Protectorates in East Africa, and a grant of £500 approved when the Bureau of Entomology was established in 1912.

satisfactory progress. It is of interest to note that he has recently described a new species parasitic on Glossina palpalis discovered in Uganda by Dr. G. D. H. Carpenter.

18. It is to be regretted that comparatively little progress has been made with the Sleeping sickness survey in the Far East, reference to which was made in last year's report. Dr. H. Macfarlane has sent valuable material from Hong Kong and Dr. A. T. Stanton from the Malay States and Indo-China; and collections of mosquitoes have also been received from Mr. F. P. Jepson in Fiji, Mr. J. C. Moulton at Kuching (Sarawak), and Dr. G. Davies in the Solomon Islands; but so far the offers of assistance from foreign Governments which have possessions in the Far East and the Pacific have not materialised. The outbreak of war will doubtless interfere somewhat with this survey; but the matter is now under consideration, and it is hoped that ultimately the Bureau will be in a position to furnish definite information as to the distribution of Glossina at the chief ports of call in the Far East.

19. Excellent results have been obtained with the Carnegie Studentships, which are generously provided by Mr. Andrew Carnegie for the purpose of enabling young men selected in this country to have an opportunity of studying the American methods of dealing with noxious insects; and once more the Committee wish to express their thanks to Dr. L. O. Howard, Chief of the Bureau of Entomology at Washington, for his kind assistance in advising and directing generally the work of the students. At the beginning of the year Mr. C. Mason, Mr. M. E. MacGregor, Mr. A. H. Ritchie, and Mr. E. Speyer were in America. These gentlemen have now all obtained appointments—Mr. Mason as Government Entomologist in Nyasaland, Mr. MacGregor as an Assistant to Professor Nuttall at Cambridge, and Mr. Ritchie as Government Entomologist in Jamaica, while Mr. Speyer has been selected for special investigations in Ceylon in connexion with the "shot-hole borer" of tea. There are now four Carnegie Students in the United States—namely, Mr. H. G. Champion, Mr. C. B. Williams, Mr. G. H. Corbett and Mr. E. Hargreaves—and a fifth, Mr. F. Dry, is about to leave for America.

20. It was proposed to hold in London in July, 1915, a Conference of the official entomologists of the Empire, with the object of discussing various questions which closely concern the interests of the various parts of the Empire, and you were good enough to give this proposal your warm support. The Dominion and Colonial Governments and the Governments of India, Egypt, and the Sudan were all invited to take part in the Conference and to send representatives. A number of useful purposes would have been served by such a Conference, but two may perhaps be specially mentioned. It would have been valuable in bringing together the official entomologists, who could discuss problems of Imperial importance in the prevention of the spread of insect-borne diseases; and it would have afforded an opportunity of placing the entomologists in closer personal touch with the Bureau of Entomology and of settling lines on which the Bureau might render further assistance to different parts of the Empire. A programme was submitted for the consideration of the Governments invited to send representatives, and among other important subjects suggested for

It will be seen from what I have said above that the Bureau is doing all that it can, with the limited resources at its disposal, to pursue actively the campaign against Glossina in our tropical African Colonies and Protectorates. The Committee would be happy if they could see their way to increase the number of experts working in the field for the Bureau, but this is quite impossible at present, and they fear that at a time when economies have to be effected on all sides the local Governments will not be in a position to provide funds for special investigators.

15. During the year a large number of collections of insects have been sent in from Africa and many parts of the Empire. These collections are acknowledged in detail in the Bulletin; the insects are all identified, and the sender is furnished with an authoritative statement of the numbers and species in the collection, together with named specimens, if desired.

In the twelve months 229 separate consignments have been received from 72 different correspondents, distributed as follows:—Africa 33, Asia 8, West Indies 7, and Australasia 4. The total number of specimens received was no less than 86,000, of which 35,000 were blood-suckers. Among the latter special mention must be made of an exceptionally fine collection of over 22,000 mosquitos (all bred) and 1,500 Tabanidæ from Dr. H. Macfarlane, Government Bacteriologist in Hong Kong.

The number of lists of identification issued during the year was 190, and these lists comprise about 4,500 specific names of insects. In this work of identification the Bureau has received much assistance from various entomological specialists, including the following members of the Honorary Committee of Management:—Mr. E. E. Austen, Prof. R. Newstead, F.R.S., Prof. G. H. F. Nuttall, F.R.S., Hon. N. C. Rothschild, Mr. F. V. Theobald, and Mr. C. Warburton.

16. These collections, when named, are at the service of such institutions as may require them. In the report for last year mention was made of the collections of ticks and blood-sucking flies issued to the British Museum, the Universities of Oxford, Cambridge, Edinburgh, Aberdeen, and Manchester, the London and Liverpool Schools of Tropical Medicine, the Royal Veterinary College (Camden Town), the Imperial College of Science and Technology, the Museums at Birmingham, Leicester, and Warrington, and the King Institute of Preventive Medicine at Madras. In the year which has just ended further collections have been sent to several of these institutions, and also to the Birmingham Natural History and Philosophical Society and the Bedford College for Women. In addition to 2,200 blood-suckers and insects of agricultural importance, over 41,000 other insects were presented to the British Museum.

17. While dealing with this side of the work, I should refer to the fact that arrangements have been made for the identification of lice and the investigation of the minute beneficial parasites of the family Chalcididæ. Mr. James Waterston has been engaged by the Bureau for this purpose, and he has made very